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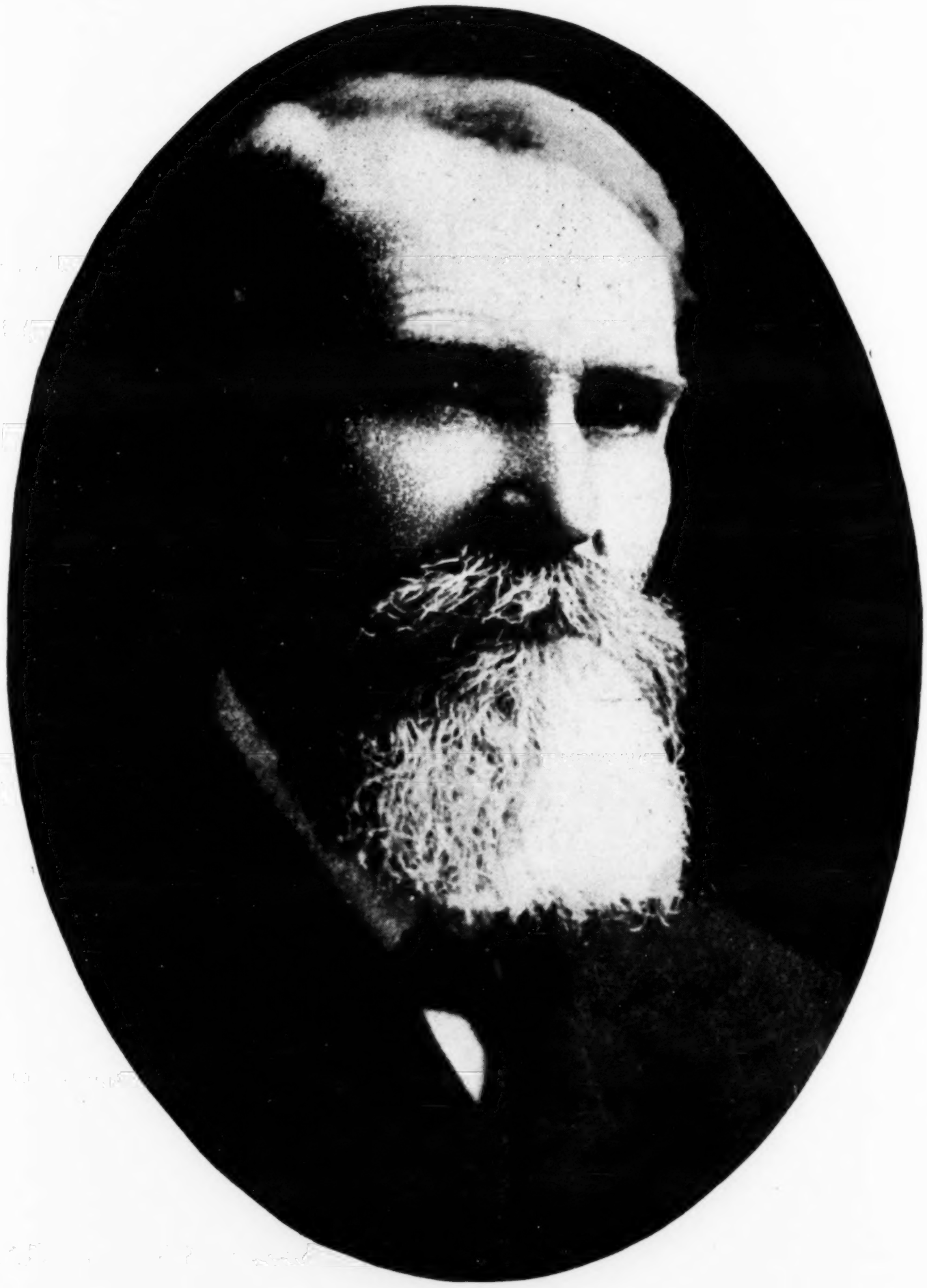

James L. Reid

For putting old King Corn on his billion dollar throne—a pittance

VOLUME 21 SEPTEMBER, 1930 NUMBER 9

The American Genetic Association

An incorporated organization devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks

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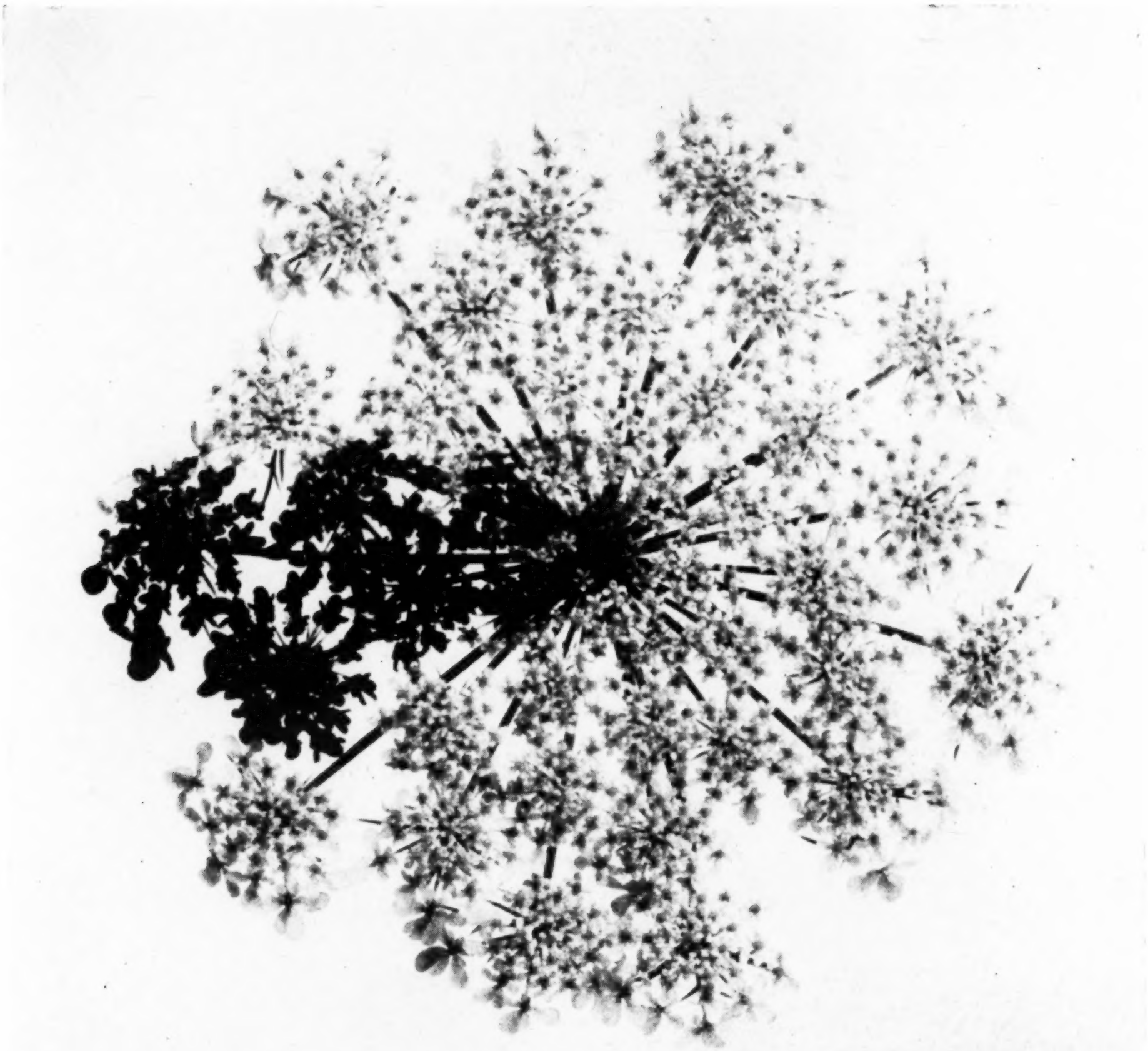


CHIMERA OR ACCIDENT OF DEVELOPMENT?

Frontispiece

A FLOWER-CLUSTER of the wild carrot (*Daucus carota*) having an entire sector of dark flowers, instead of one or a few such flowers at the center.

The photograph was generously sent us by Miss Edith M. Patch, of the University of Maine, who thus describes the flower:

"The entire dark sector had flowers which matched in shade the "usual" dark flower (one to several) at the center of the umbel. The botanists call this color "dark purple." I am not sure how the shade would score from the Ridgeway color keys. From memory it seems not far from "Victoria Lake" and "Maroon" on Plate I.

"If you care to use this photograph as an interesting specimen of variation, you are welcome to it. I have noticed that the number of "maroon" flowers at the center of the umbel varies from one to several but the specimen photographed is the only example I have seen of a maroon sector."

Ordinarily a sectorial chimera is thought of as resulting from genetic change in part of a plant. This being an extension of a condition normally occurring in a restricted area raises an interesting question of whether it is strictly speaking a chimera or whether it deserves some other designation.

—*Editor.*

THE EFFECT OF IMMIGRATION ON THE BIRTH RATE OF THE NATIVES

WELD A. ROLLINS

BENJAMIN FRANKLIN in his remarkable "Observations Concerning the Increase of Mankind and the Peopling of Countries," written in Pennsylvania in 1751, says:

> The importation of foreigners into a country, that has as many inhabitants as the present employments and provisions for subsistence will bear, will be in the end no increase of people, unless the newcomers have more industry and frugality than the natives, and then they will provide more subsistence, and increase in the country; *but they will gradually eat the natives out.* Nor is it necessary to bring in foreigners to fill up any occasional vacancy in a country; for such vacancy (if the laws are good) will soon be filled by natural generation.

As to Franklin's first proposition that the importation of foreigners, etc., will be in the end no increase of people, it is interesting to note in a recent census monograph,[42] after a discussion of the huge increase of population between 1910 and 1920:

> And yet, although the figure denotes a population growth of such dimensions, its significance lies not in the fact that it was so large but rather in the fact that it represented the smallest percentage of increase ever reported by a Federal census. * * * The extremely low rate of population increase for the last decade was a continuation of the tendency previously pointed out as having become marked since 1870, but which had never before been so pronounced. * * *

"The extremely low rate of population increase," it should be noted, was larger than in most well settled countries, but was small for the United States, and the birth rate in the Registration Area has been getting lower and lower, having descended from 24.9 per thousand of population in 1915 to 19.7 in 1928 (Utah and Massachusetts lacking).‡ This is far lower than the birth rate of any country in Northwestern Europe at any time during which statistics appear to have been kept until that of France descended to the same figure in 1907.[32] It has been calculated that assuming a complete cessation of immigration and the existence of the 1910 mortality rates, a birth rate of 19.42 would result in our having a stationary population.* Apparently we are approaching, a point where for a period of greater or less duration we shall have "as many inhabitants as the present employments and provisions for subsistence will bear" without a reduction of the standard of living.†

---

‡The Bureau of the Census has announced the 1929 birth rate as 18.9.

*Professor MacIver, in *Population Problems*,[15] P. 305. See also the estimate of Dr. Dublin on page 12 *Ibid.*

†"They suggest that unselected immigration has already brought the United States to the point where over-population and the radical lowering of the standard of living seem to be imminent; it has presumably accelerated the tendency toward small families among the most competent." (Huntington,[30] P. 313).

"Unless a change occurs promptly there is genuine danger that within the lifetime of our children this country may be so densely populated that it will be face to face with problems as serious as those of Europe, while Europe may be confronted by problems almost like those of China." Huntington,[30] P. 363).

"By 1890, the cost of living had begun to rise and the standard of living to fall." (Reuter,[15] P. 24).

"H. P. Fairfield has shown how the standard of living declined from 1890 to 1908."[43] (Fairfield's study, it should be said, was confined to wage earners.)

"It is possible that immigration added something, though a diminishing amount, to the population of the East (of the United States) taken as a whole before the industrial changes of the seventies or eighties; but it is doubtful if it has added anything since then." (Bushee,[4] P. 314).

As for Franklin's second proposition, that if the new comers have more industry and frugality than the natives they will gradually eat the natives out, it is interesting to note the shrewd vagueness of the phrase "eat the natives out." Anyone can see for himself in New England and New York that the immigrants have "eaten the natives out," but the method by which it has been accomplished is not so clear. The census monograph just referred to[42] has this to say about it:

> The late Francis A. Walker, Superintendent of the Tenth Census, whose contributions to scientific population analysis are of the highest order, advanced the theory that the reduced increase of the native stock was the result of contact and competition with the foreign element, beginning about the middle of the last century. This theory has been vigorously opposed and as a complete explanation has not been accepted, but in one respect it is certainly true. The coming of the foreign element into the life of the Republic stimulated industrial activity, railroad construction, manufacturing, and development of all kinds. These great economic changes in turn tended to make over the social conditions of the Nation, and in the complexities arising in that direction is undoubtedly to be found the principal cause of decreasing increase of a stock originally so prolific. Thus, General Walker's theory may be accepted as reasonably correct, though perhaps in a roundabout way.

Other statements of the principle are given below:*

It will be seen that Franklin's proposition has been vindicated. Inasmuch as it must have been deduced from past experience, it apparently rests on a broader basis than adventitious railroad construction, etc., although the con-

---

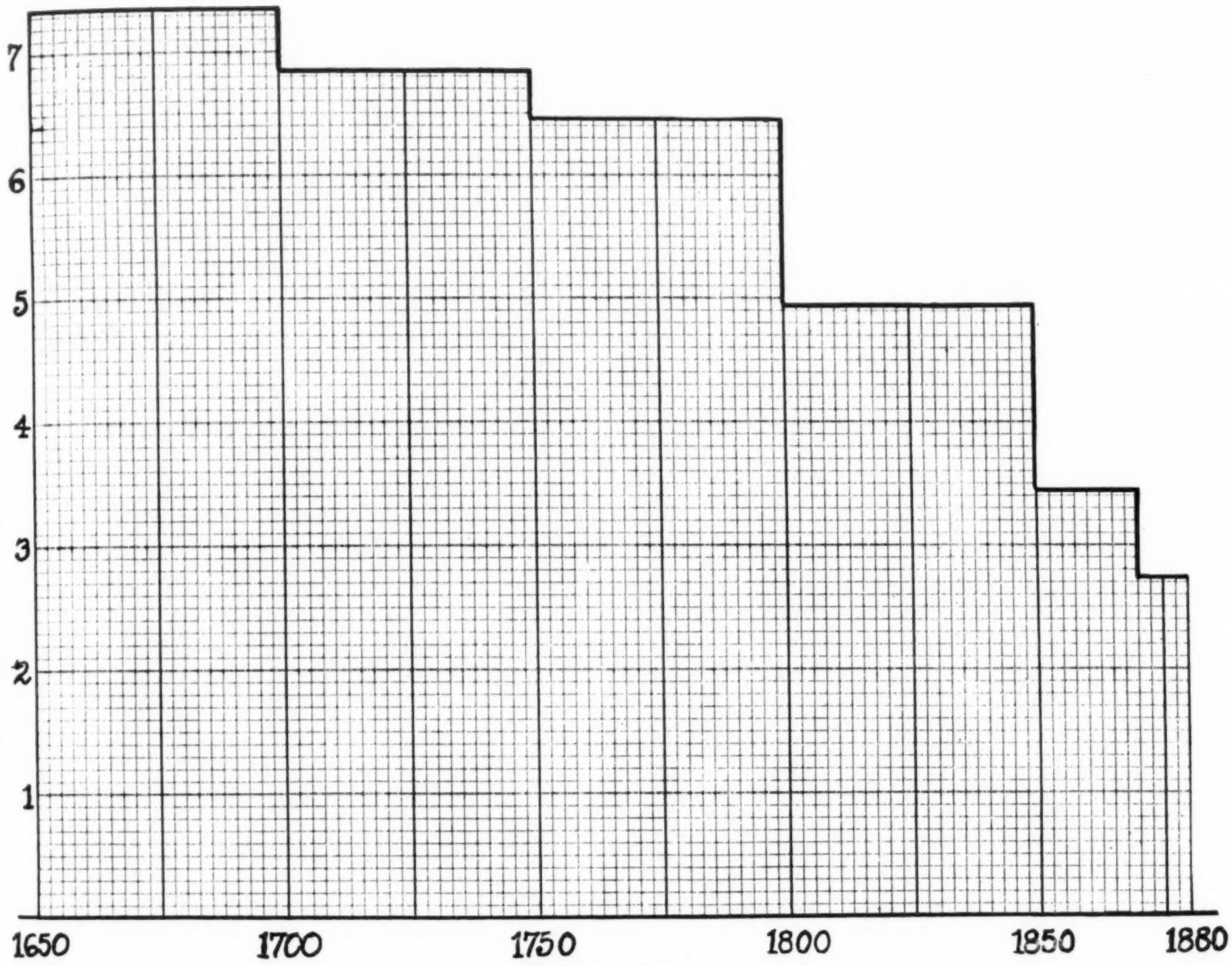
*"In such a country, however, the only net result appears to be that which we have pointed out—diminished numbers, increased well-being. It is otherwise where an old community, jealous of its comforts and trained in self-restraint, is planted amidst strangers of a ruder type, content with less comfort, and multiplying accordingly. Thus, in old times, the pure-blooded Spartans, and similar oligarchical races, died gradually out. In Hungary, the more advanced tribe of Magyars is stationary in numbers; the Slav and the Rouman swarm in their beggary. In Transylvania there is one small and remarkable people, the 'Saxons' or descendants of German settlers—well-to-do, industrious, and peaceful—who have nevertheless diminished one-third in fifty years; they will not have children, as their ministers complain, in order not to diminish their substance; while their neighbors and quondam drudges, the Wallachs or Roumans, marry young and multiply exceedingly, and will soon occupy the quaint old Saxon settlements with their healthy ragged colonies. And, strange to say, the same law of advancing civilization seems to be working itself out in America. We are already told that in Massachusetts, not only is the birth-rate, taken on the whole, nearly stationary, but that the increase, such as it is, is due solely to the immigrants; that 'the foreign population have from two to three times as many births as the American, and it follows that the American deaths actually exceed the births.' The Americans are so prone to give exaggerated pictures of the unfavourable as well as the favourable circumstances in their condition, that we receive such statements under considerable reserve; but they are probably not without foundation. And thus it would seem the first ranks in the advancing army of civilization are continually decimated: but the masses from behind press in to fill up the gap.—Pall Mall Gazette." (Duncan,[16] Note, P. 186).

"As soon as means of controlling the size of the family are known, then of two classes, or peoples, or races, competing within the same area, *the one which has the lower standard of living tends to displace the one which has the higher standard.*

"The reason is that the former curbs its fertility less than does the latter. It has been found in Europe that, where nationalities of unequal cultures compete in the same field on equal terms, the one with the inferior culture expands at the expense of the other by the simple process of outbreeding it." Citing several instances. (Ross,[41] P. 318).

"There is little doubt that the coming of immigrants has lowered the standard of living of the native whites, especially the laborers, during the latter part of the nineteenth century, and rather than have their standard lowered, a very large proportion of the native stock has lowered its birth rate instead." (Good,[22] P. 482).

"If the Melting Pot is allowed to boil without control, and we continue to follow our national motto and deliberately blind ourselves to all 'distinctions of race, creed, or color.' the type of native American of Colonial descent will become as extinct as the Athenian of the age of Pericles, and the Viking of the days of Rollo." (Grant,[23] P. 228).



DECLINING FERTILITY OF NATIVE STOCK

Figure 1

After 1800 the fertility of "Colonial Wives" decreased sharply. This was due in part to immigration.

struction and operation of railroads have no doubt played their part. In connection with the making over of social conditions, it may be worth noting that Massachusetts in 1826 passed legislation intended to universalize the high school, and in 1852 passed a compulsory education act, and that the large development of our present educational agencies throughout the country began just after the culmination, about 1860, of a pronounced immigration movement.*

The population of the United States in 1820, when immigration statistics begin was less than 10,000,000. Since then, 37,000,000 immigrants have come in and settled for the most part where slavery did not exist. It has been calculated[48] that between 1790 and 1820 arrivals were as follows:

From	1790	to 1800	50,000
From	1800	to 1810	70,000
From	1810	to 1820	114,000

*"In short, our study shows that though in 1867 a beginning had been made in most of the activities of education, nothing more than a beginning had been made. The development, therefore, of all the great present-day agencies of education—free graded elementary schools, intermediate schools, high schools, normal schools, the great universities, schools for the negro and the Indian, vocational schools, the great foundations * * * is the growth of the last fifty years. This statement refers to changes so colossal that the mere effort to think of them one after the other is stupefying." (Moore[35]).

The following figures show the estimated net immigration by decades since 1820:

Decade	*Net Immigration All Races*
1820-1830	137,000
1830-1840	558,000
1840-1850	1,599,000
1850-1860	2,663,000
1860-1870	2,356,000
1870-1880	2,530,000
1880-1890	4,273,000
1890-1900	3,239,000
1900-1910	5,558,000
1910-1920	3,467,000
1920-1930, approximately	3,250,000

The immigrants have been mostly laborers. Laborers are always fertile and immigrants are always fertile. They have multiplied. But have not the natives, who employed the immigrants and presumably made a profit from it, and who had the political control of the country and the better opportunity for education, multiplied too?

The foregoing chart (Figure 1), made from figures compiled by Crum[11] from a study of genealogies of twenty-two American pioneer families which originally settled in New England or the Middle Atlantic States, shows what has happened to the birth rate of the natives in the north.

It will be seen from the above that for the first 150 years, *i. e.*, up to 1800, the families were large, consisting of well over six children; that they were growing gradually smaller, but that the change in this direction was slow and regular. It is said that during this period there was not much immigration, even on a percentage basis.* The fifty-year period beginning with 1800, however, is very different. It shows a very pronounced drop in the size of families,—three or four times as great a drop as what had theretofore been normal.

What was it that happened in that half century between 1800 and 1850 that made the size of families decrease from well above six to below five? If you will look back at the table of immigration you will see that a couple of million of immigrants came in. Was there not room in so big a country for two million immigrants? I suppose that there was, but apparently it became harder for the natives to support a wife and family according to the prevailing standard of living.

Turning back to Figure 1 again, we find in the twenty-year period following 1850 another pronounced drop in the number of children. This drop is even more pronounced than the last because the period from 1850 to 1870 is only twenty years instead of fifty. Referring to the table of immigration, we see that five million immigrants came in.

Going back to Figure 1 yet again, we find for the ten-year period between 1870 and 1880 another large drop, and we observe from the table of immigration that two and one-half millions of immigrants came in. Married ladies of Colonial stock were having less than three children now, not much more than enough to reproduce the race, for not every one was married, and not all of the children would live to maturity. The natives were, apparently, being "eaten out." Crum's conclusion, as the result of his investigation, was in effect that unless a change came soon the colonial stock would become extinct, and that the reason for it would be the desire for material luxuries.

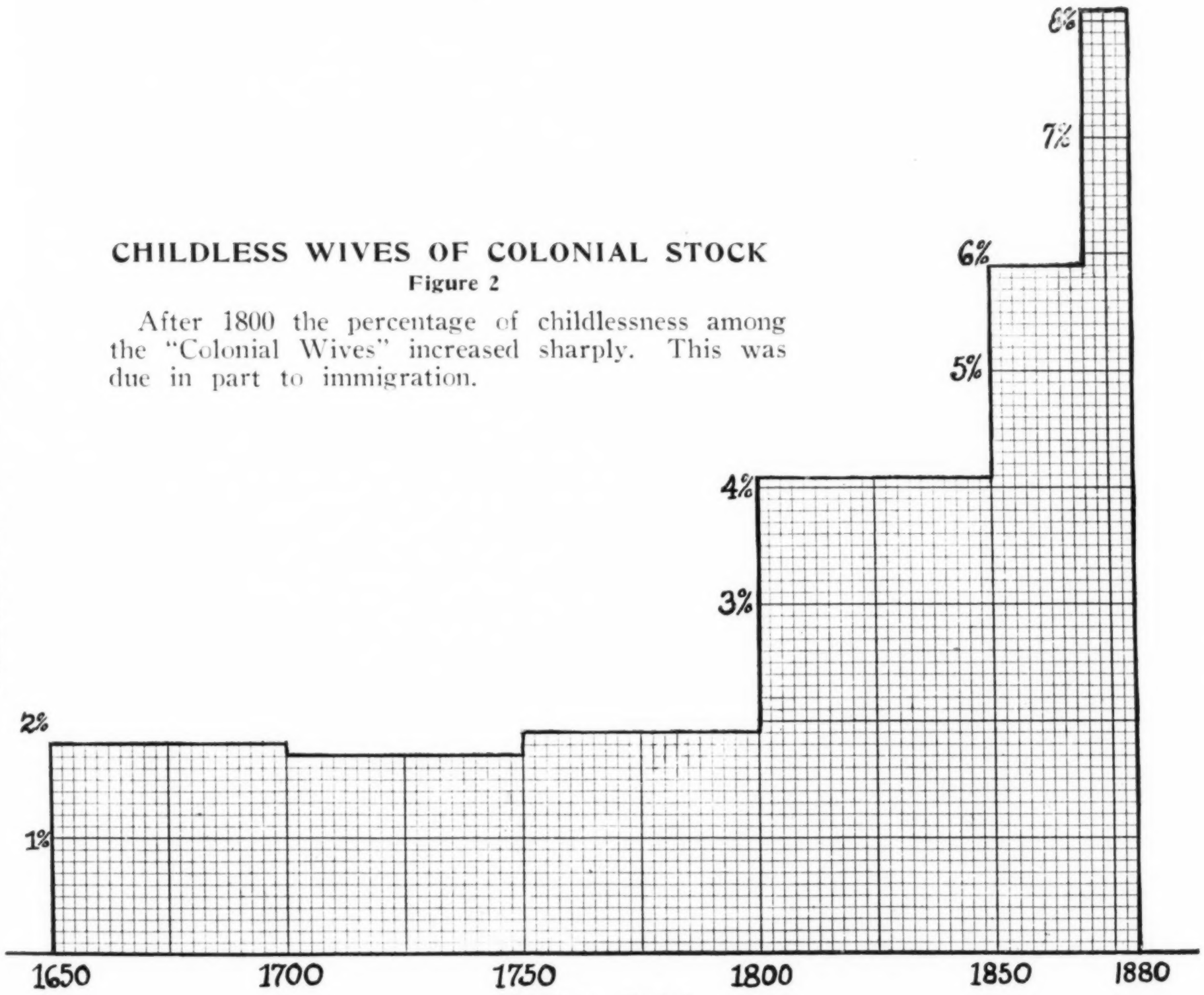
The difference in conditions which had come about since the 18th century is well brought out by some statements of Adam Smith,[44] written apparently shortly before the American Revolution:

> Labor is there [the American colonies] so well rewarded, that a numerous family of children instead of being a burden, is a source of opulence and prosperity to the parents. The labor of each child, before he can leave their house, is computed to be worth a hundred pounds clear gain to them. A young widow with four or five children, who, among the middling or inferior ranks of people in Europe, would have so little

*East,[17] P. 266. In Channing's *History of the United States*, Vol. 2, P. 492, it is computed, however, that "almost one-third of the colonists in 1766 were born outside of America."

CHILDLESS WIVES OF COLONIAL STOCK
Figure 2

After 1800 the percentage of childlessness among the "Colonial Wives" increased sharply. This was due in part to immigration.



chance for a second husband, is there frequently courted as a sort of fortune. The value of children is the greatest of all encouragements to marriage. We cannot, therefore, wonder that the people in North America should generally marry very young. Notwithstanding the great increase occasioned by such early marriages, there is a continual complaint of the scarcity of hands in North America. The demand for laborers, the funds destined for maintaining them, increase, it seems still faster than they can find laborers to employ.*

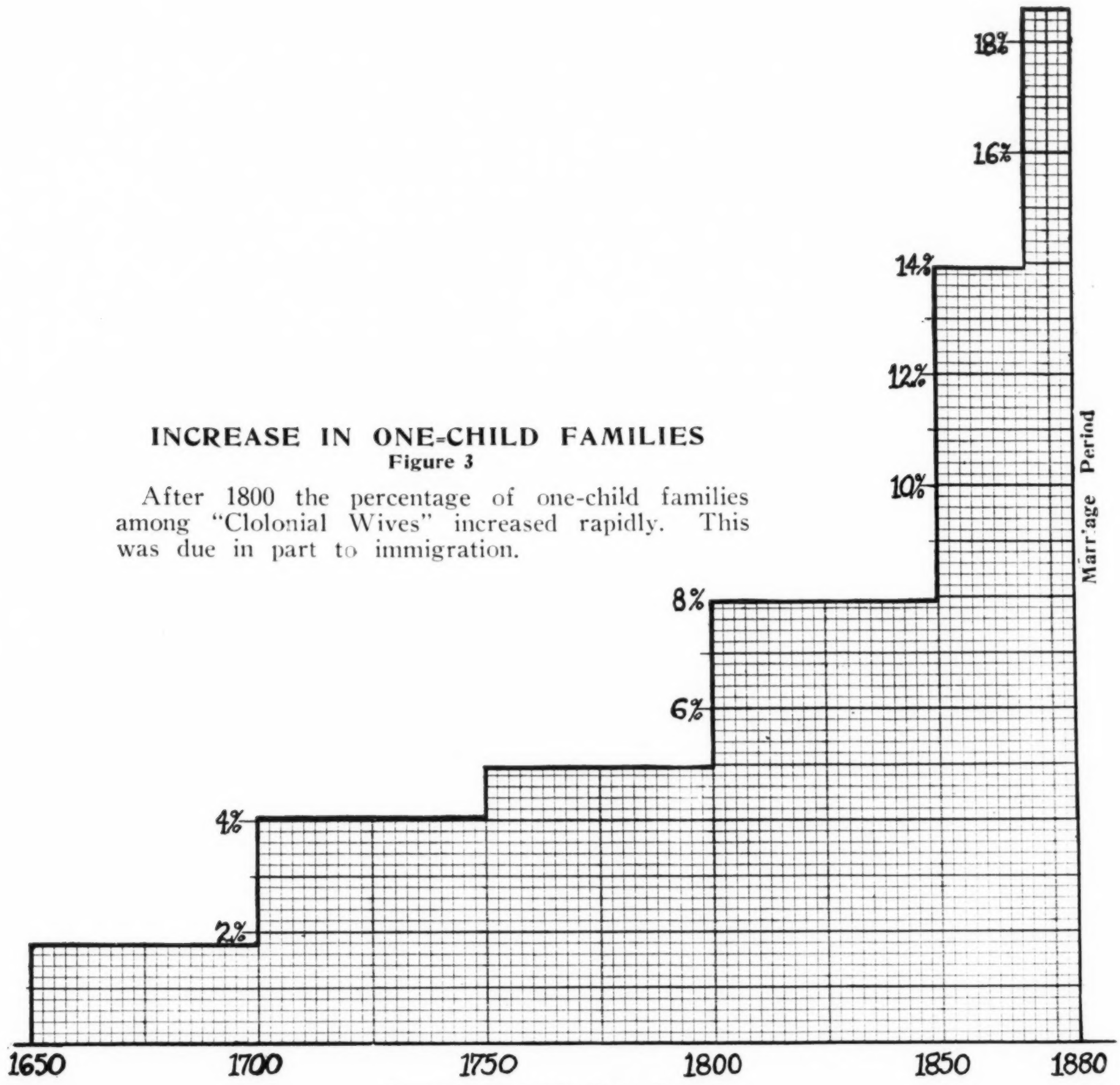
A further detail of the same lessening of families among the native stock is presented in Figure 2. It is also taken from Crum's figures and shows the percentage of childless wives.

It will be seen that for 150 years or so down to 1800, the percentage of childless wives stayed constant at less than two per cent, that in the half century following 1800 the percentage more than doubled, and by 1880 had quadrupled. That is, during the long period before 1800, when immigration was slight, the percentage did not increase at all, and in the short period, after immigration began in substantial volume, the percentage increased very fast.

Another detail is shown by another chart (Figure 3) of the colonial wives, and that is the one-child family.

It appears from this figure that up to 1800 the one-child family had gradually, over a period of 100 years or so, become two and one-half

*Speaking of early colonial days in America, Professor Sumner[46] says that a farmer's "children are not a burden, but a help; they offer the only aid which he can hope for, since the relation of hire is impossible. If his sons, as they grow up, go off and take up land of their own, it is an advantage to him to have many sons, that the series may last as long as his own working years." (P. 296).



INCREASE IN ONE-CHILD FAMILIES
Figure 3

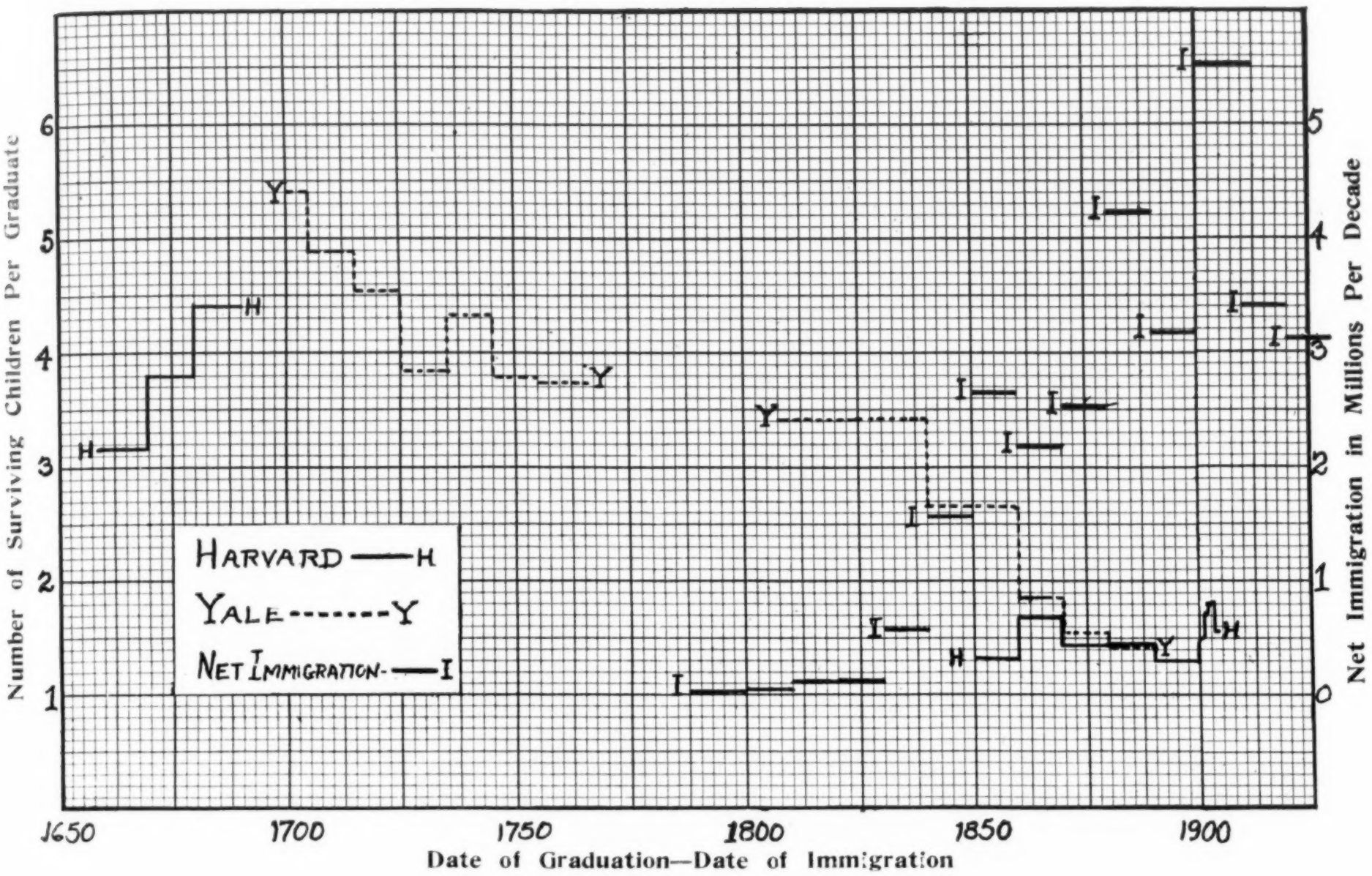
After 1800 the percentage of one-child families among "Clolonial Wives" increased rapidly. This was due in part to immigration.

times as common as it had been. A comparison of this figure with the preceding one shows that people began limiting their families to one child a long time before they took the more drastic step of having no children at all and that when immigration began in great quantity, between 1800 and 1850, the one-child family along with the no-child family increased in prevalence by leaps and bounds.

Figure 4 is a graph showing the average number of surviving children born to Harvard and Yale graduates,* and a graphical representation of the net volume of immigration.

It will be seen from Figure 4 that by piecing together the average number of children of Harvard and Yale graduates we get a record from substantially the earliest times to the most recent class but one that the nature of

*This chart is made from the following sources: Down to 1850 from the figures compiled by Hall[25], 1850 to 1900 from figures compiled by Phillips[38], 1901 to 1904 from Harvard Class Reports. "Surviving" apparently in the earlier days means surviving to maturity; since 1850 it means surviving to at least the date of the twenty-five year report, at which time the children would average to be about thirteen years of age. Dr. Phillips states that the figures for Harvard between 1850 and 1860 are not reliable, and the line for Harvard on the chart for that decade is, therefore, not reliable.



GRADUATES' FAMILIES AND IMMIGRATION

Figure 4

Immigration reduces the fertility of college graduates. Note how for about a century preceding 1840, or a little earlier, the size of Yale graduates' families did not decrease very rapidly, but about that time began to decrease abruptly, the abrupt decrease continuing some thirty or forty years, and the curve then flattening out somewhat for about thirty years. Note also how the short horizontal lines representing net immigration in millions begin to go up very pronouncedly a little before 1840 continuing the abrupt ascent for thirty years, after which they are a little lower for twenty years. The noticeable increase in the Harvard families after 1900 appears to be largely due to the World War, and to its accompaniments.

the inquiry permits us to analyze. There are two gaps in the record which it would be interesting to fill, but which do not seriously detract from the value of the graph. The reader will observe the following:

From 1658 to about 1700, the size of surviving families increases rapidly. From about 1700 to say 1725 it decreases rapidly. For the next century and a little more, which period apparently includes the time when, as recorded by Adam Smith, children were such an asset, it decreases very slowly, the average number of surviving children being well above three and generally below four. About 1841, however, the size of families begins decreasing very rapidly, passing the reproduction point,—a little above the line marked 2,—about 1860 and remaining below that point ever since. In the three classes, 1901, 1902 and 1903, there was a progressive recovery followed in 1904 by a drop to 1.58 surviving children per graduate, but this 1.58 was more than the average for any decade since 1870. If the average for the decade beginning in 1901 shall turn out to be more than for the preceding decade, it will, so far as these figures go, be the first rise in a descending birth rate among college graduates for more than a century and a half.

It will further be seen that the short horizontal lines representing net immigration drift upwards as the birth rate of the graduates, beginning about 1841, makes its abrupt descent, that where between 1860 and 1880 there was a cessation of increase in immigration,

there followed a flattening of the curve representing the children of graduates, and that where the short horizontal lines reflect recent reductions in immigration, there it is that the birth rate of the college graduates goes up. It is not believed, however, that the recent rise in the Harvard birth rate is due solely to the diminution of immigration. Other causes doubtless have affected it, but the reduction of population pressure probably had something to do with it. In addition to decreased immigration, it will be remembered that many men were in 1917 and 1918 withdrawn from competitive activity by being segregated in cantonments or sent overseas, and many immigrants returned to their homes to join the armies of their respective nations. The tendency towards bigger families began, it may be mentioned in passing, at least as early as the Class of 1897, the recovery from the financial depression of 1893 apparently having some effect. It may further be of interest that coincident with the rise in the Harvard birth rate came a pronounced reduction in the percentage of unmarried graduates and of childless marriages.

It may be objected, however, that the net immigration numerically considered is not so pertinent to the subject of this inquiry as the net immigration on a percentage basis would be. In order to see how the net immigration on a percentage basis correlates with the size of families of the college graduates, the following graph (Figure 5) has been made.

It will be seen from this graph that the immigration on a percentage basis was low in the forty years preceding 1830 and went rapidly to a peak in the 1850-1860 decade, and that meantime, with a little lag, the fertility of the college graduates rapidly declined. From 1860 to 1920 the net immigration on a percentage basis has declined, and similarly the chart shows a decided checking of the rapid decline in the size of families of the college graduates. Where net immigration on a percentage basis has latterly become relatively low, the birth rate of the graduates has become higher.

Although in the middle of the nineteenth century the upper classes in Great Britain began having fewer children than the lower classes, and this difference became very pronounced, not quite such an extreme condition came into existence there as Figures 4 or 5 show developed here.* What the situation may be since the World War is not here under consideration, but in the latter half of the nineteenth century the professional men in Great Britain reproduced themselves, graduates of girls' colleges averaged substantially more children than the graduates of our girls' colleges, and the graduates of Oxford and Cambridge, if one may judge from a limited number of genealogies, had enough children to much more than perpetuate their line. How the matter stood in Continental Europe during this period, I have not looked into, but in a general sort of way since Europe increased largely in population and, nevertheless, sent out emigrants, perhaps it is deducible, subject to some exceptions, that the birth rate among the higher classes of society, compared with the United States, at least, may have been fairly satisfactory. The northern part of the United States since the middle of the last century seems to have been in an unique and highly undesirable situation. G. Stanley Hall, late President of Clark University, after going very exhaustively into the low birth rate of New England college graduates says:[25]

> Something is clearly wrong, and more so here than we have at present any reason to think is the case among the male or female youth of other lands.†

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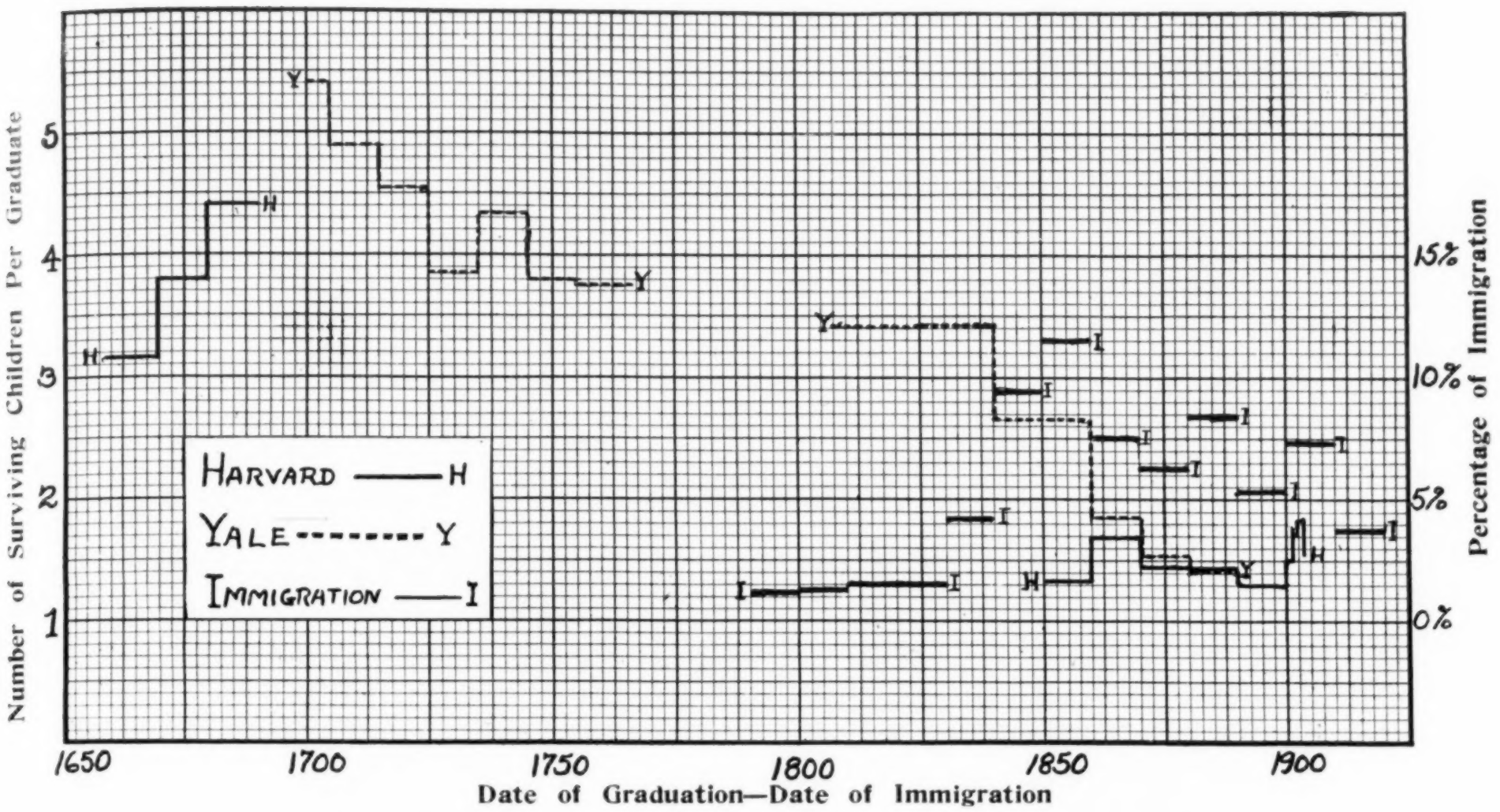
*See Census of England and Wales, 1911. Vol. XIII, Part II.

†"The American intellectual groups are much less fertile than similar European groups." (Stoddard,[45] P. 111).



VARIATION IN IMMIGRATION PERCENTAGES
Figure 5

The lines in this figure representing the children of Harvard and Yale graduates are the same as those in Figure 4. The lines representing immigration, however, represent not net immigration in millions, but percentages to population. Note how the immigration on this basis ascends rapidly from 1820 to 1860, the college families, after a little lag, descending with corresponding abruptness for about the same length of time. After 1860, the immigration on a percentage basis goes steadily down, and the decrease in college families ceases its abrupt descent, and after 1900 these families for four years show an average increase.

In the southern part of the United States, which has been avoided by immigrants, the colonial stock has held its own and increased.

In passing, it is instructive to note the comparative volumes of immigration. A volume of less than three million net per decade—or indeed perhaps half of that—apparently rendered it impossible for the college graduates to reproduce themselves after say about 1860, although there was almost unlimited free land, but the volume that has prevailed since 1920 has been at a somewhat greater rate than three million. People are accustomed to think that immigration has by the Acts of 1921 and 1924 been reduced within safe limits, but we are taking in, net, every three and one-third years as many people as there are in the City of Boston. The limitation under the present quota law, which applies only to the Old World, is about 1,500,000 gross per decade, but there are exemptions, and there is no quota limit to the natives of the New World who may come in. From 1922 to 1928 inclusive, where one person has come in under the quota, one and a half in addition came in outside the quota. Incidentally, as to one of the most undesirable sources,—the countries south of our own,—there is no quota limitation whatever.*

Birthrates and Immigrant Percentages

If immigrants do in fact eat out natives, we ought to be able to see evidence of it, not only by studying the birth rate of the natives over a

*"Approximately one out of fifteen of the present generation of Mexicans has left his homeland for the United States * * *. This movement, the greatest Indian migration of all time, will have to be curtailed * * * " (Glenn E. Hoover [29] P. 99).

period of years and comparing it with the volume of immigration, the method already employed, but also by examining the different sections of the country at any one time and seeing whether the natives have least children where there are most immigrants and *vice versa*. A search of the census monographs discloses that the fertility of the native born has been calculated for different areas.[42] The list about to be set out shows the results. It begins with New England having the lowest fertility, represented by the figures 13.6, and ends with the group of states made up of Mississippi, Alabama, Tennessee and Kentucky having the highest fertility, represented by figures about twice those for New England. Over against each section of this list, I have put the percentage of immigrants and their children living in that section.[7] This percentage is confined to white immigrants and their children because that is the way the census figures are compiled, but the exciusion of colored immigrants ought not to make any difference as the number is very small.

Fertility of Native Whites		*Percentage of White Immigrants and their Children enumerated in Division*
New England	13.6	61.0
Middle Atlantic	15.5	54.0
Pacific	17.2	44.3
East North Central	18.8	42.6
West North Central	20.7	37.9
Mountain	24.1	36.3
West South Central	26.3	11.3
South Atlantic	26.3	6.2
East South Central	26.7	3.1

It will be seen from the foregoing that as the percentage of foreign stock diminishes, the fertility of the natives increases, or, put the other way round, the more foreign stock the less children of the native stock.* It will also be observed that there is no exception to the correlation. The reader will be surprised to learn that the size of his family has been affected by the number of immigrants and their children in his part of the country. Perhaps he will say that that is absurd, that all the figures amount to is that there are more cities in the north than in the south, that the birth rate is lower in cities than in the country, that the immigrants have gone mainly to the cities, and that the list would have arranged itself in the same order if there had been no immigration at all. This comment would, indeed, be perfectly fair because if the same sections of the country are arranged according to the percentage of people living in urban communities, or the percentage of native white of native parentage living in urban communities, the list assumes substantially the same order: that is, the more urbanness the fewer babies. This, however, does not dispose of the matter, for why are there fewer babies in cities? It appears to be in part because of the same or a similar phenomenon: the movement of population into the cities.†

*This appears also to have been true at an earlier date, for Francis A. Walker,[48] writing in 1891, says:

"And it is to be noted, in passing that not only did the decline in the native element, as a whole, take place in singular correspondence with the excess of foreign arrivals, but it occurred chiefly in just those regions to which the new-comers most freely resorted."

"This development [industrial development] further explains the fact that the native birth rate has declined most noticeably in those sections of the United States to which immigrants have chiefly gone." (Davie[12]).

The census monograph mentioned in the text also gives the fertility of the natives for ten states. If these are correlated with the percentage of foreign stock, they tell substantially the same story. Similarly the fertility of the natives living in comparable cities tends to vary with the percentage of the foreign element living in such cities.

†"In cities, where all trades, occupations and offices are full, many delay marrying till they can see how to bear the charges of a family; which charges are greater in cities,

Figures 4 and 5 are as to surviving children per class member, but if this is converted onto the basis of children born per married graduate it becomes comparable with Crum's table of "Colonial wives." Such a comparison shows that the Harvard and Yale graduates over the whole period of two hundred and twenty-two years had always averaged substantially less children than the "Colonial wives" of the general community.[40]

Now then, as the foreigners eat out the natives, who are the first to go? The college graduates or the "Colonial wives" who represent the Colonial stock generally? It is the college graduates. It seems quite extraordinary that it is the college graduates, with whom the immigrants do not come into direct competition, that are the first to be eaten out, but so it appears to be. Over a period of half a century following 1850, about 40% of the graduates of Harvard and Yale had no children. But how about the natives who do come in direct competition with the immigrants? Are they not eaten out too? The figures show that people of Colonial stock in the North, who have had no education (when any such there were), have had more children than those with a common school education,[2] those with a common school education more than those with a high school education, those with a high school education more than those with a college education, and that where both parents have a college education they have less children than where one only is a college graduate.[27] It would seem from this that the ones who presumably come in more direct competition with the immigrants are not so quickly eliminated as the ones who have carried their education further. Perhaps they are not eaten out at all. And it seems likely that the negroes are not eaten out. At any rate, their numbers have steadily increased.[6]*

Part of the process that has been going on, therefore, has been a gradual extinguishment of educated stocks and a substitution of immigrants and their children.†

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as luxury is more common. * * * The deaths are more than the births. * * * Only as the cities take supplies of people from the country, and thereby make a little more room in the country, marriage is a little more encouraged there and the births exceed the deaths. * * * There is, in short, no bound to the prolific nature of plants or animals, but what is made by their crowding and interfering with each other's means of subsistence." (Franklin[19]).

*In spite of a high death rate "Substantially all of the 10,000,000 negroes in the United States are descended from the 700,000 women of this race found here in 1810." (Walker[47]).

†"When Immigrants Belong to the Lowest Class"————

"But a considerable addition of immigrants to the *lowest* class will make the struggle for life much more intense, thus altering the economic environment. Now a change in the environment must also change either standards of living, or rates of multiplication, or both. That class in the population which has no special standard of comfort to maintain will show the effect of the excessive competition in a lower standard of living, indicated both by increased poverty and a higher rate of mortality: especially among infants. That class in the population which has acquired standards of comfort will show the effects of the increased competition by a lower marriage or birth rate, for it will not easily abandon its standard of living. The middle class, as well as the upper stratum of the lowest class, will be affected, and the results will be especially noticeable in the rising generation. The immigrants themselves may not become identified with the middle class, but they are likely nevertheless to compete with them either directly or indirectly and to render their position less secure." (Bushee,[4] P. 310).

"Now comes the last and saddest part of the story. For some reason every selected race seems to degenerate. Ordinarily the growth of luxury and idleness are given as the causes. * * * Another important cause of racial deterioration is the restriction of the birth-rate which almost invariably becomes active among the upper classes when over population begins to create a condition of economic stress." (Huntington,[30] P. 18).

Now what are the reasons back of these curious phenomena, the steady reduction of the birth rate of the natives continued for more than two and a half centuries, its accelerated reduction when the immigrants come in, and the earlier elimination of the educated? They seem to me to be in part these: Natural generation advances by geometric progression. If the original settlers had seven children per married couple and each of their children had had seven, and so on, the continent, and indeed the world, would speedily have been unable to contain the population. There would at some time, then, have had to come infanticide, or war, famine and pestilence,—the positive checks of Malthus. This is apparently the present state of affairs in China, where in some of the provinces at least the average family has been about six children.[24] A more humane and civilized alternative, and one more in accordance with self-interest, was to have progressively fewer children,—Malthus' preventive check. This is what has happened in America. But how have the people known how many children to have? It seems to me that it has been borne in on them by economic pressure,—the increasing difficulty of making a living as good as others of the same social class. Immigration appears to augment this difficulty for most of the natives. If the economic pressure is caused by the geometric progression just mentioned, the arrival of immigrants would naturally increase it. When the Greeks monopolize the fruit business, the Italians the barber business, and so on, the natives are forced to make their livings in the remaining occupations only, and their numbers must, therefore, be *pro tanto* reduced from what they otherwise would be, i. e., their fertility has to decline. As for the low birth rate of the college graduates, there has always been in this country a differential fertility adverse to them. When the immigrants have come in and absorbed the humbler occupations, the natives being thus forced into the remaining ones* and their fertility accordingly reduced, the college graduates have not been able to perpetuate themselves. This result has presumably been intensified by the national policy of higher education largely at public or charitable expense.

It is not intended in this article to discuss in any detail the possible effects of the principles under consideration but it would seem that extended over a considerable time they must be very far reaching indeed. If we should adopt the method of the geologists,—who observe the forces about them, imagine their results over a protracted period and check their conclusions by conditions which they see existing, it would be possible to develop a science of great importance.

What follows is suggestive merely.

Just as the natives are eaten out by the immigrants, so today's immigrants will be eaten out by tomorrow's. The kind of people most capable of receiving education will, it would seem, tend to be gradually eliminated in favor of kinds less capable of receiving education.† The character of the popula-

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*"An 'almost startling' slowing-up in the rate of increase of college registrations last year (1928-29) was noted by Dr. Adam Leroy Jones, Director of Admissions of Columbia University, in his annual report. In twenty-two states last year there were fewer college and university students than in the previous year.

"Dr. Jones cited the restriction of immigration and the small rate of increase of native population among possible causes of the slump." *New York Times,* October 2, 1929.

†"It can be said with confidence that differential fecundity between occupational groups is having a rather slight, but unquestionable, depressing effect upon the mental-test ability of the rising generation in the United States." (Hart[26]).

"The potentialities within each race are constantly diminishing, owing to the segregation of the best germ-plasm from the lower levels." (East,[17] P. 253).

"In this sample (Massachusetts school children) completed families with a child in the lower levels of intelligence are approximately twice as large as completed families with

tion of New England has been deteriorating for a long time,—at least since the first half of the 19th century,* possibly since about 1820,[30] at which time, it will be recalled, the immigrants had begun to come in in some volume, and it may be much longer than that. The elimination of the valuable middle classes and the creation of a small group of very rich, ruling a peasantry or proletariat, has been said to be brought about by some such principles as those under examination.† The passing out of existence of races also re-

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a child in the upper levels of intelligence. The stocks represented in this sample which are producing retarded or mentally defective children are more than maintaining themselves,"—the mothers of such children being predominantly foreign born. (Dayton[14]).

" 'Feeble-mindedness in which the seeds of a vast amount of criminality repose, is constantly on the increase.' " (Levy[33]).

"Of the 1,566,011 recruits examined by our psychologists in 1917 and 1918, 25.3 per cent were unable 'to read and understand newspapers and write letters home.' Unable to take the alpha examination, which any good third or fourth grade pupil ought to manipulate easily, they were given the beta examination for illiterates. If this relationship holds in the general population where in 1920 there were nearly 83 million people aged 10 years and over—and there is absolutely no reason for assuming that it does not hold—then there are over 20 million people in the country who are fitted for nothing above the position of common laborers. * * * In great proportion they could never rise far beyond their present condition because of their heredity." (East,[18] P. 315).

"The general conclusion of most students of vital statistics is that those elements of the population exhibiting subnormal mentality show the highest gross fertility, while those elements having the greatest intellectual capacity court extinction by their relative sterility." (East,[17] P. 262).

*"We of the English speech patronize the nineteenth century, smile derisively at the mid-Victorian; but has the generation now passing produced anything comparable? It should have done so, for it is the ripest fruit of the democracy we laud and cherish. We have, of course, only rough standards of measurement. Among American universities Harvard once graduated distinguished men in notable numbers. But not of late. Thanks to the democratization of education during the latter part of the nineteenth century, the president of the university signed the sheepskins of as many young men as all his predecessors back to 1636; yet as against the multitudinous worthies of the past—from the Adams family in politics, Bancroft, Prescott, and Motley in History, Asa Gray and Shaler in Science; Emerson, Holmes, and Lowell in letters, down to William James—President Eliot's graduates included only one leader of the higher order, and he was no New Englander—Roosevelt. This fact was pointed out by a Harvard graduate. In the same period many other universities doubled and redoubled their numbers. Can graduates of any of them tell a different story?" (Corbin,[9] P. 186).

"America already has, probably, the lowest grade mental life of any of the modern nations" (Adams[1]).

The fifty-nine individuals of American birth elected to the Hall of Fame were born in the decades indicated below:

1700	'10	'20	'30	'40	'50	'60	'70	'80	'90	1800	'10	'20	'30	'40	'50	'60
2	0	0	4	1	3	5	2	5	8	11	9	4	4	0	1	0

Numerically more were born between 1800 and 1810 than at any other time. But in proportion to white population, the three born between 1750 and 1760 are more than the eleven born between 1800 and 1810, so that it looks as though there was a descending scale from the 1730-1740 decade.

"We believe that the standard of the bar in the Commonwealth of Massachusetts is in serious danger of deteriorating, and indeed is already deteriorating. The members of our committee come from different parts of the Commonwealth, but we are unanimous in this conclusion, and our conviction is strengthened by the Chief Justice of the Municipal Court of the City of Boston." (Committee on Legal Education[8]).

See also Munro[36]; Huntington[30], Pp. 308-310.

†"If all the estimates cited are correct, it indicates that, since 1896, there has occurred a marked concentration of income in the hands of the very rich; that the poor have, relatively, lost but little; but that the middle class has been the principal sufferer." (King[31]).

"The negroes brought into the English sugar islands have greatly diminished the whites there; the poor are, by this means, deprived of employment, while a few families

sults from the same eating-out process,* as well, in some instances, as the decline of nations,† and one is permitted to speculate whether the strange but pronounced quality of unprogressiveness, characteristic of the populations of most countries once the seat of great civilizations, may not perhaps sometimes be due in part to the same or similar agencies.‡ Moreover, a sufficient accumulation of data might reveal that the birth, adolescence and maturity, as well as the senescence of civilizations, the so-called cycles of civilization, are sometimes correlated with the differential birth rate, the ascent taking place during a period when superior stocks have more children than inferior ones.

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acquire vast estates." Franklin's Observations Concerning the Increase of Mankind and the Peopling of Countries[19].

Of the sixty-five persons elected to the Hall of Fame, two were born in the West Indies: Alexander Hamilton, born in Nevis in 1757; and John James Audubon, born in Haiti in 1785. Probably most persons do not regard these islands nowadays as a breeding place for genius.

See also Davis[13]; Cox,[10] P. 135; Willey,[49] P. 271; Buckle,[3] Ch. 1.

*"In the second century (B. C.) the tide had turned, at all events in the Greek peninsula; and Polybius had no doubt as to its cause. Love of display, love of money, and love of ease, are the three reasons which he assigns for the reluctance of his contemporaries not merely to rear children, but to marry at all. Families, usually limited to one or two 'so as to leave these rich,' were brought up extravagantly as a 'leisured class' and given no incentive to work." (Myers[37]).

"All authorities agree that the ancient Hellenes were decidedly long headed. * * * At all times from 400 B. C. to the Third Century of our era it would seem proved that the Greeks were of this dolicocephalic type. Stephanos gives the average cranial index of them all as about 75.7. * * * The modern Greeks are a very mixed people. * * * The cephalic index of modern living Greeks ranges with great consistency about 81." (Ripley,[39] P. 407). (In other words, the Greeks of the early days have largely ceased to exist and this would seem to be due to the low birth rate mentioned by Polybius).

†"Previous to the fall in each case (Greece and Rome) there was an influx of immigration, a freeing of fecund slaves, and a decline in the birth-rate more marked in the upper classes." (East,[17] P. 265).

"Without venturing to discuss the various explanations of the downfall of civilizations it may be said that, so far as insight can be obtained in the racial changes that have accompanied this process of decay, the ethnic stocks which were responsible for the cultural advancement that occurred become gradually bred out and replaced by the blood of alien peoples." (Holmes,[27a] P. 381).

"When the equality of property, which had formerly prevailed in the Roman territory, had been destroyed by degrees, and the land had fallen into the hands of a few great proprietors, the citizens, who were by this change successively deprived of the means of supporting themselves, would naturally have no resource to prevent them from starving but that of selling their labour to the rich, as in modern states; but from this resource they were completely cut off by the prodigious number of slaves, which increasing by constant influx with the increasing luxury of Rome, filled up every employment both in agriculture and manufactures." (The author then says that the "strange and preposterous custom" of distributing corn to the poorer citizens arose, not enough for a family but too much for an individual, so that they could not increase, and refers to the *jus trium liberorum.*)
"If half of the slaves had been sent out of the country, and the people had been employed in agriculture and manufactures, the effect would have been to increase the number of Roman citizens with more certainty and rapidity than ten thousand laws for the encouragement of children." (Malthus,[34] P. 147).

Edward Lucas White in "Why Rome Fell" (1927), lists as two of the causes the influx into Rome and Italy of aliens, whether free or slaves, and a depleted supply of recruits for the legions. Pp. 261, 270, 271, (i. e. not enough of the native stock).

‡"Previous civilizations have ended simply and solely in a decline, generally accompanied by internal disturbances and sometimes completed by foreign invasion. In Egypt and China and Babylon nothing in particular happens, but the soul of civilization has departed. The people sink into what Spengler calls a fellaheen existence, in which the only interest in life is the need of the moment, and population mainly agricultural, lives a hand to mouth existence without politics, without art, without science, and without ideals. * * *

What has happened is that eminent writers, thinkers, politicians, artists, and the rest of them, no longer come into existence; thought and literature and the spirit which can hold together a great organized empire have passed, and with them everything of real value." (Goddard and Gibbons,[21] Pp. 196, 199).

"In spite of the security and 'quiet transmission of heredity, wealth and position' which marked the Isaurian reform movement, the Byzantine population was artificial, easily shifted, and subject to rapid changes of character. The same is true of any modern capital recruited from the provinces and draining their surplus, soon to perish in the new environment: the Berliners have within forty years been almost ousted by a foreign race. But this is in a singular degree true of the capricious if prudent creation of Constantine. An old inhabitant returning after an absence of twenty years would find the *personnel* of the government, the composition of the crowd, unrecognizable." The foregoing is as to the time after the plague of Constantine V. (*C.* 750 A. D.) (Bussell,[5] Vol. II, P. 144).

"But the Greeks of Constantinople, after purging away the impurities of their vulgar speech, acquired the free use of their ancient language, the most happy composition of human art, and a familiar knowledge of the sublime masters who had pleased or instructed the first of nations. But these advantages only tend to aggravate the reproach and shame of a degenerate people. They held in their lifeless hands the riches of their fathers, without inheriting the spirit which had created and improved that sacred patrimony: they read, they praised, they compiled, but their languid souls seemed alike incapable of thought and action. In the revolution of ten centuries, not a single discovery was made to exalt the dignity or promote the happiness of mankind. Not a single idea has been added to the speculative systems of antiquity, and a succession of patient disciples became in their turn the dogmatic teachers of the next servile generation. Not a single composition of history, philosophy, or literature, has been saved from oblivion by the intrinsic beauties of style or sentiment, of original fancy, or even of successful imitation." (Gibbon,[20] P. 42).

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James L. Reid

ONE of the least appreciated activities in the world is that of improving our grain crops. The pioneers in this field rarely receive more than a pittance in pecuniary return, and none of them have ever become Burbanks, in spite of contributions easily comparable. The recently enacted plant patent law while smoothing the road for future Burbanks, gives grain breeders no help in obtaining either recognition or an adequate return for years of patient and devoted labor.

Among the pioneers in placing King Corn on his throne was James L. Reid, originator of Reid Yellow Dent corn, a variety which has added millions to the wealth of the nation—as much as seventy-five per cent of all the maize grown in the corn belt states being said to trace to the strain developed by Mr. Reid.*

Reid Yellow Dent corn was produced by the crossing of two distinct varieties: one, called Gordon Hopkins corn, was brought by Mr. Reid's father when he moved from Ohio to Illinois in 1845-6. The other, "Little Yellow," was a variety grown in the neighborhood of Delevan, Ill., where the Reid family made their new home. These varieties were grown in mixed plantings in 1846, and it was from this stock that James Reid began his work of selection a few years later. In 1867 he began farming for himself, and in 1877 he grew a field yielding 125 bushels per acre without fertilizers or special cultural methods. Not until the Columbian Exposition in Chicago in 1893 did his corn become widely known.

Mr. Reid appears to have had no elaborate methods of selection. He had a clear idea of the type toward which he was working, and the ears for seed were selected in the field, with many factors considered. He is said to have stressed as most essential the two factors, vigor and per cent of corn to ear. About five per cent of the corn from the highest yielding field represented his seed supply for market.

*For a more extended biographical note the reader may refer to: "Who Put King Corn on the Throne?" *Breeders Gazette,* vol. 83, No. 3. Jan. 18, 1923.

FINGER-PRINTS IN MONOZYGOTIC TWINS

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ALMOST as soon as the study of finger-prints was taken up scientifically the matter assumed such great importance in criminology and demography that the study of these anatomical characters from the biological and genetic point of view was overshadowed and neglected.

Except for Féré's studies of the variability of finger-prints and their symmetry in the two hands, and those of Sénet and Forgeot on the heredity of finger-types, and Wilder's comparisons of finger and palm-prints in twins, few authors have considered the biological aspects of the problem.

Féré in studying 182 cases of finger-prints with Galton's method found that the thumb and the forefinger, as fingers that had evoluted farther in adaptation to function, have a greater variability in the disposal of the prints.

As to the symmetry of shapes of the corresponding fingers of the two hands, the same author found that we have more frequently symmetrical types in little-fingers (74.24%), and then in decendant order in middle-fingers, ring-fingers, thumbs, and fore-fingers (42.09%).

He does not state whether the symmetry is more frequent with certain types of prints than with others.

Sénet and Forgeot's researches deny heredity of digital types (except in idiots, where great uniformity is encountered, and many degenerate shapes of ape-type).

According to these authors there is missing in twins the equality similarity in finger-prints alleged by some, although a greater type-affinity is admitted.

More recently Wilder demonstrated that there is a near likeness between finger and palm-prints in monozygotic twins, and often forms of reversed symmetry between the two individuals, particularly in the forefingers.

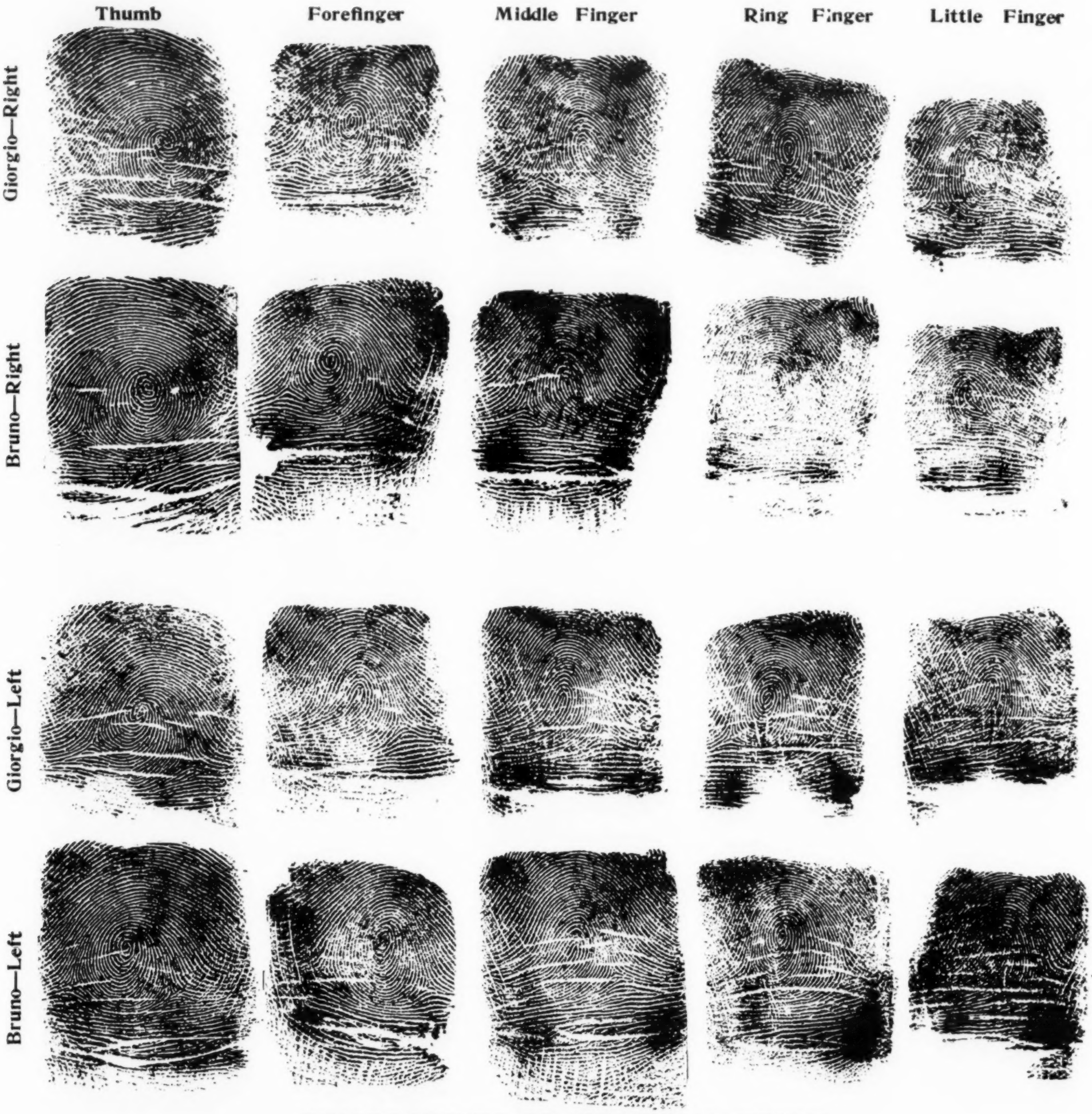
As a twin myself, and on the advice of Prof. Paolo Enriques and of Prof. Enrico Tedeschi, I have undertaken a research concerning finger-prints in our family, which is composed of father, mother, and five sons, of which two are twins, in order to see if there are any similarities in finger-print type in the members of the same family, and if there is a greater affinity between the two monozygotic twins than between the other brothers.

I am showing here only the finger-prints of the twins (Fig. 6), those of the other brothers and of the parents are illustrated only schematically in the table (Fig. 7) where the number of lines, counted from the center of the figure as far as the "delta" is also indicated.

The distinction of finger-type (winding line, concentric circles, loop, simple arc) is adopted by all systems of classification now used, as first distinction of characters Within the groups so formed, other criteria are successively followed: number of lines, their bifurcations, number of sudoriferous pores, etc.

Some one will observe that in my researches I am considering only the finger-type, but only with this criterion it is possible to put into evidence some affinities between certain members of the same family and to distinguish them from the others. That is very interesting from the biological point of view, for it puts twins on much nearer categories than the other brothers and limits the differences of twins with respect to character anatomically and embriologically less important to a narrower variability-field.

In our case there is also an interesting fact of reversed symmetry between



FINGERPRINTS OF IDENTICAL TWINS
Figure 6

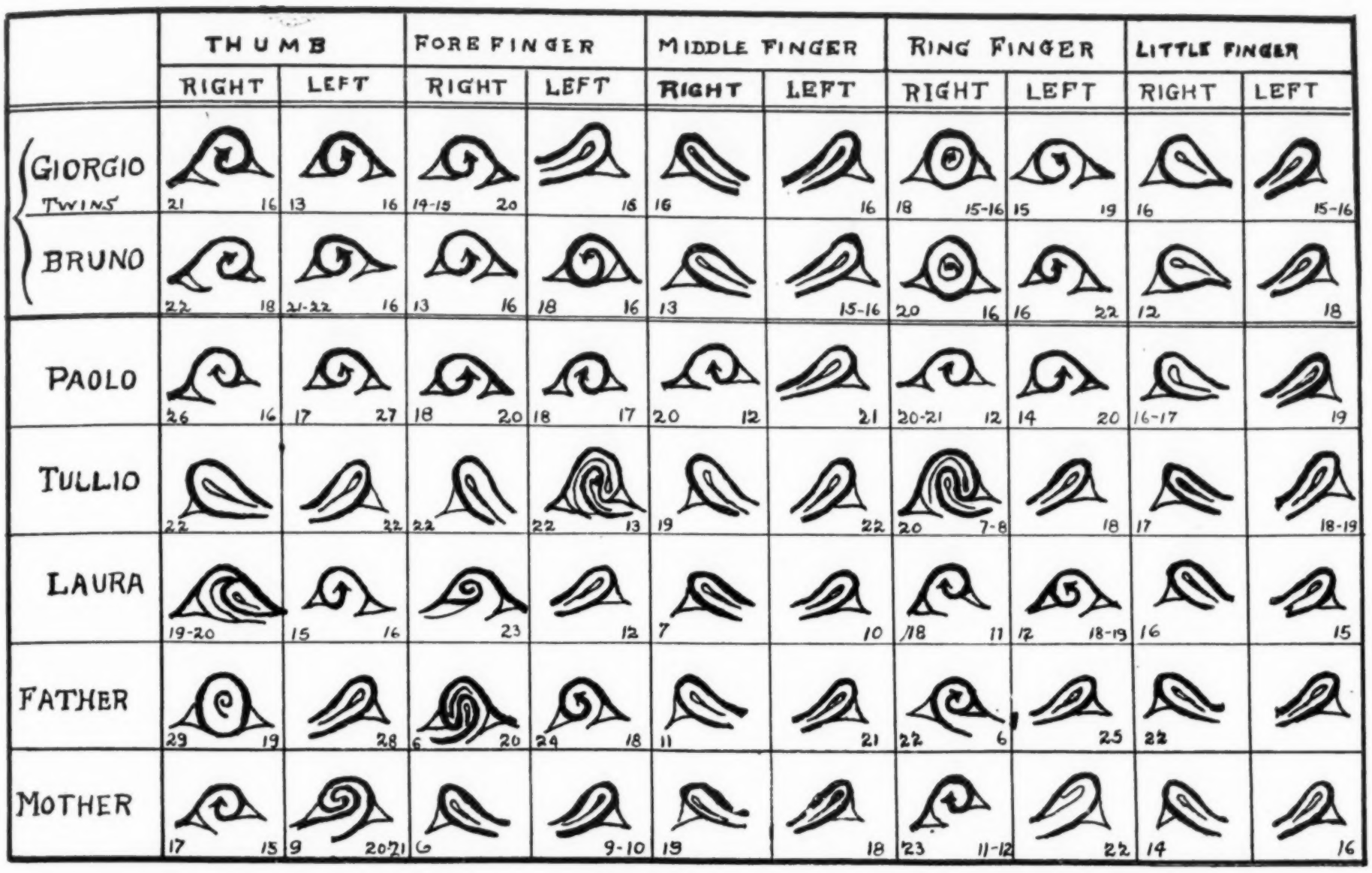
Showing the same-sided symmetry in fingerprint patterns. Only the forefingers on the left hands have patterns markedly unlike.

the twins, which is emphasized by a congenital dislocation in the articulation between phalanx and first metacarpal of the right thumb in Giorgio, in the left one in Bruno.

This phenomenon appears sometimes also in non-twins, but I mention this fact because the phenomena of reversed symmetry are often taken as a criterion of monozygotic origin (Newman).

Several facts result from the examination of Figure 7 that may be briefly summarized:

1. There is an evident greater resemblance between twins than between the other individuals. Namely: all the correspondent fingers in the twins have an identical type; excepting the forefingers (Giorgio with loop, Bruno with winding line[1]), which fully confirms Féré's observations, that ascribe a greater variability to forefinger and thumb, and those of Wilder in three



FINGERPRINT PATTERNS OF TWINS, AND THEIR PARENTS AND SIBS

Figure 7

The fingerprints of Paolo resemble the twins' fairly closely, and he resembles them in other ways also more than did the other brother and sister. The numbers accompanying the patterns are the number of lines from the center of the figure to the "delta"—recognized as an important criterion in dermatoglyphics.

cases of twins with different or asymmetric prints only in forefingers.

However, this greater variability of forefinger results also from the lesser quantity of symmetrical forms. I must note that the right ring-fingers have in both twins a transition-type between spiral line and concentric lines, and perhaps with a symmetric hint between Giorgio and Bruno.

2. One of the brothers, Paolo, who presents a greater physical resemblance to the twins, has also a complex of finger-types which more resembles the twins' than do the other brothers, that are of a quite different physical type, and that very likely are heterozygotic, in character fair haired variable with age; whilst G. B. and P. are homozygotic (black), (Fisher), as if there were a certain connection between the different characters.

3. The little-fingers are similar in all the members of the family, and also the left middlefinger, which corresponds to the lesser variability of these fingers according to Féré.

4. In all the members of the family the loop-forms are turned with the convexity towards the thumb (radial loop). If this fact were confirmed in other families, too, it would perhaps lead us to suspect that the radial character has a definite hereditary basis.

5. The symmetry between corresponding fingers in the two hands of the same individual is perfect only in the loop forms, that is, when in the two corresponding fingers there are loops, they are always symmetrical, without exception.

As to the other forms, considering, for example the ring-fingers, we see that while there is symmetry between the two hands in Paolo and Laura (right and left spiral), in the twins there is also a spiral but of a parallel type. This fact is, in its peculiarity, a twin-affinity character. But what we noted above must not be forgotten,

that is, that all loops are radial, and therefore necessarily symmetrical in the two hands, which casts a doubt on the diagnostic importance of the symmetry facts we have considered.

Concluding, we cannot absolutely speak of an identity of fingerprints of the twins (differences in left forefingers and in numbers of lines) or of a presumed symmetry between the right side of a twin and the left one of the other, ascribing it to the embryogenesis of monozygotic twins, but there is certainly a greater anatomical affinity between them, which confirms Sénet's and Newman's researches.

However, it would be interesting to search out the heredity of characters within the types, as we have seen from the radial loop in our case, and the distribution of symmetrical forms in the different finger types, which present some doubts, and to see if what we have observed is due to casual coincidences. If similar relations appear in other families, too, they will have to be considered as hereditary phenomena.

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Lamarck and Mendelism

Sir:

I am glad that the Journal has found it necessary to publish the portrait and at least a weak paragraph on Lamarck. It was about time. Now if some one of the staff would really read Lamarck and quote what he said and not somebody's quotation of what someone has said about him, justice might at last be done this great man. Could anything be flatter and stupider than for the modern biologist to cry for the need of evolution on one page of his journal while denying on the next all possibilities for such with his insistence upon the unchangeableness of unit characters and their inheritance under the laws of Mendel!

Very respectfully yours,

General Hospital, Cincinnati.

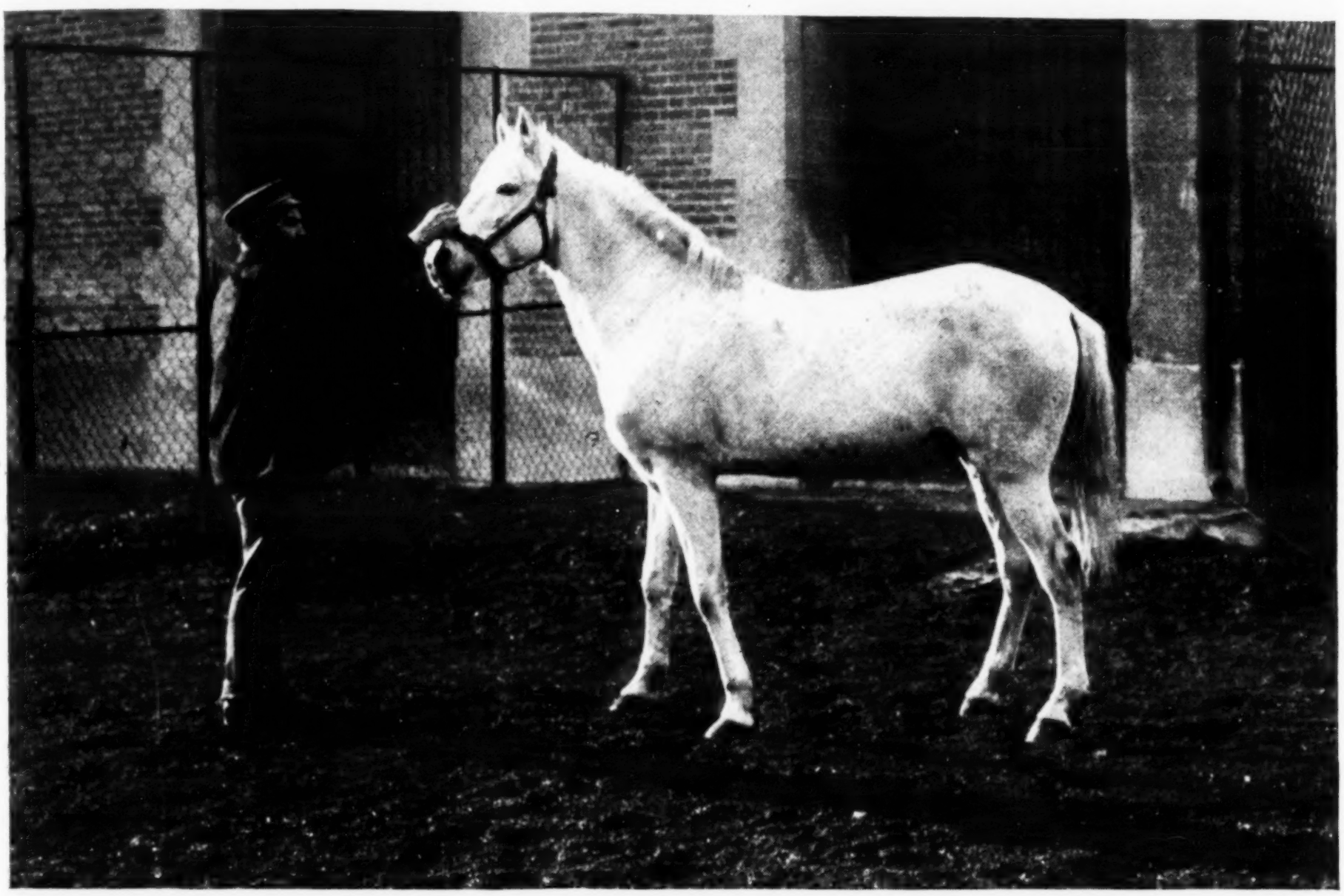
Dr. Martin H. Fischer

The quotations from Lamarck were not rehashes, but Packard's translation of his own words—reliably believed to be reasonably accurate. We are sorry our *six* paragraphs proved so weak; they were well intended. Mendelians do not deny that unit characters *change*. They know they do. The point at issue is *what makes them change?—Editor.*

EARLY INSTANCES OF FERTILE MULES

J. Baashuus-Jessen

State Stud-Book Registrar of Norway. Oslo



A MULE'S FOAL

Figure 8

A cross between a mule and a stallion exhibited in Paris prior to 1900.

IN connection with the article "A Fertile Mule" in No. 9 on page 413, 1928, I beg to call attention to the following passage in an article "On Mule-Breeding in France," published December 3, 1897, in the Danish Magazine *Tidsskrift for Hesteavl* by the late Professor G. Sand, of The Royal Veterinary and Agricultural College in Copenhagen:

Already in ancient times it had been ascertained as a fact, that mules were not able to reproduce themselves. So inveterate in the consciousness of people was this belief of sterility in mules that the Babylonians for instance, during Cyrus's siege of their town, defiantly shouted to the Persians, that ere would the mules fole than they (the Persians) would be able to take their town, and such firm belief has survived until our time. Of course, there is no doubt that mules, as a rule, are sterile, but on the other hand there are quite a number of well supported reports to the fact, that female mules have been pregnant with either jacks or stallions, further that they have born fertile offspring. Even ancient Roman authors (*inter alia* Varro and Plinius) state such cases, which from their point of view necessarily had to be interpreted as something miraculous and absolutely contrary to nature and therefore foreboding disaster; and so late as in the middle of the 18th century the same view caused Spanish workmen to leave a South American silver mine, because one of the mules had born. The mare and her foal were burned at the stake, but even after this atoning offering the workmen did not rely upon the wrath of the Heaven having therewith been appeased. The mine was deserted.*

*Hahn: Die Hausthiere und ihre Beziehungen zur Wirtschaft des Menschen, page 181. 1896.

The fact, however, that such superstitious ideas have been able to exist up to present days demonstrates how rare, indeed, are these instances of fertility in mules. Quite instructive in this respect is also Ayrault's* explicit statement that in Poitu (the centre of mule-breeding in France) nobody has ever heard of pregnant mules, though in this place we should think the most favourable conditions for conception would exist, since the female mules are turned out on the pastures together with young male mules and consequently often are being served by the latter. We can, therefore, say without exaggeration that fertile female mules are very rare and that fertile male mules are not known at all

The photograph shown is due to the late Professor Harald Goldschmidt of the above mentioned college and represents a cross between mule and stallion, which prior to 1900 was exhibited at Jardin des Plantes in Paris.

Non-Heritable Downlessness in Chickens

SEREBROVSKY and Petroff reported in a recent number of this JOURNAL (20:331-332) a case of downlessness in chicks that they interpreted as being heritable. None of the downless chicks found by them lived to be tested and their conclusions regarding the heritability of the character were drawn from pedigrees.

During the 1926 breeding season there was hatched from the Kansas Agricultural Experiment Station flocks a Single Comb White Leghorn chick that was completely downless. This chick at hatching resembled very closely the one reproduced in the article by Serebrovsky and Petroff. Abnormalities of the leg scales described by these authors were not noted in the chick appearing in the Kansas flock; however, a careful examination was not made with this condition in mind.

The downless chick here reported upon appeared to be entirely normal in other respects and its growth was much like that of other chicks of its breed in the same hatch. Both the rate of feathering and the adult plumage were normal for the breed.

The downless individual was a male and during the 1927 season was mated with four females that had normal down at hatching. From this mating there were produced 63 chicks all of which had normal down. Five of the normal F_1 generation females were mated to their father and 65 F_2 generation chicks were produced all of which showed normal down development.

These results are considered to indicate that this case of downlessness was not heritable. Two other downless chicks appeared in our hatches but neither was given a breeding test. The results are not taken as necessarily contradictory to those of Serebrovsky and Petroff but only as showing that some cases of downlessness are non-heritable. It is possible that the defect may be of the same nature as rumplessness (JOUR. HERED. 16:127-134) where both the heritable and non-heritable types appear. However, until downless individuals have been shown to transmit the character, the heritability of the defect may be questioned.

D. C. WARREN.
Kansas State Agricultural College.

*Ibid, page 177.

GENETICS OF COTTON

A Survey of Our Present Knowledge

THOMAS H. KEARNEY

(*Concluded from the August Number*)

Seed Fuzz, Color

CROSSING Upland cottons having different colored fuzz or short hairs on the seeds, Carver[8] reported green dominant to white and a ratio of 3:1 in F_2. Similar dominance and segregation were shown when a variety having brown fuzz was crossed with a variety having white fuzz, white, therefore, being recessive to both of the other colors. The cross green × brown showed green dominant in F_1. The F_2 and F_3 populations were too few and too small to permit determination of the factors involved but progenies of 4 brown-seeded F_2 plants comprised browns and whites in various proportions but no greens, while progenies of 5 green-seeded F_2 plants comprised either greens only or greens and browns, but no whites.

The inheritance evidently is more complicated in inter-species crosses but data obtained by Balls[5] (p. 145) McLendon[38] and Kearney[27] (p. 7) for Upland × Egyptian and Upland × Sea Island showed green always dominant to white.

Lint, Abundance

Abundance of the lint may be expressed by the lint percentage:

$$\frac{\text{weight of lint}}{\text{weight of seeds} + \text{lint}} \times 100$$

or by the lint index

$$\frac{\text{weight of lint}}{\text{Number of seeds}} \times 100$$

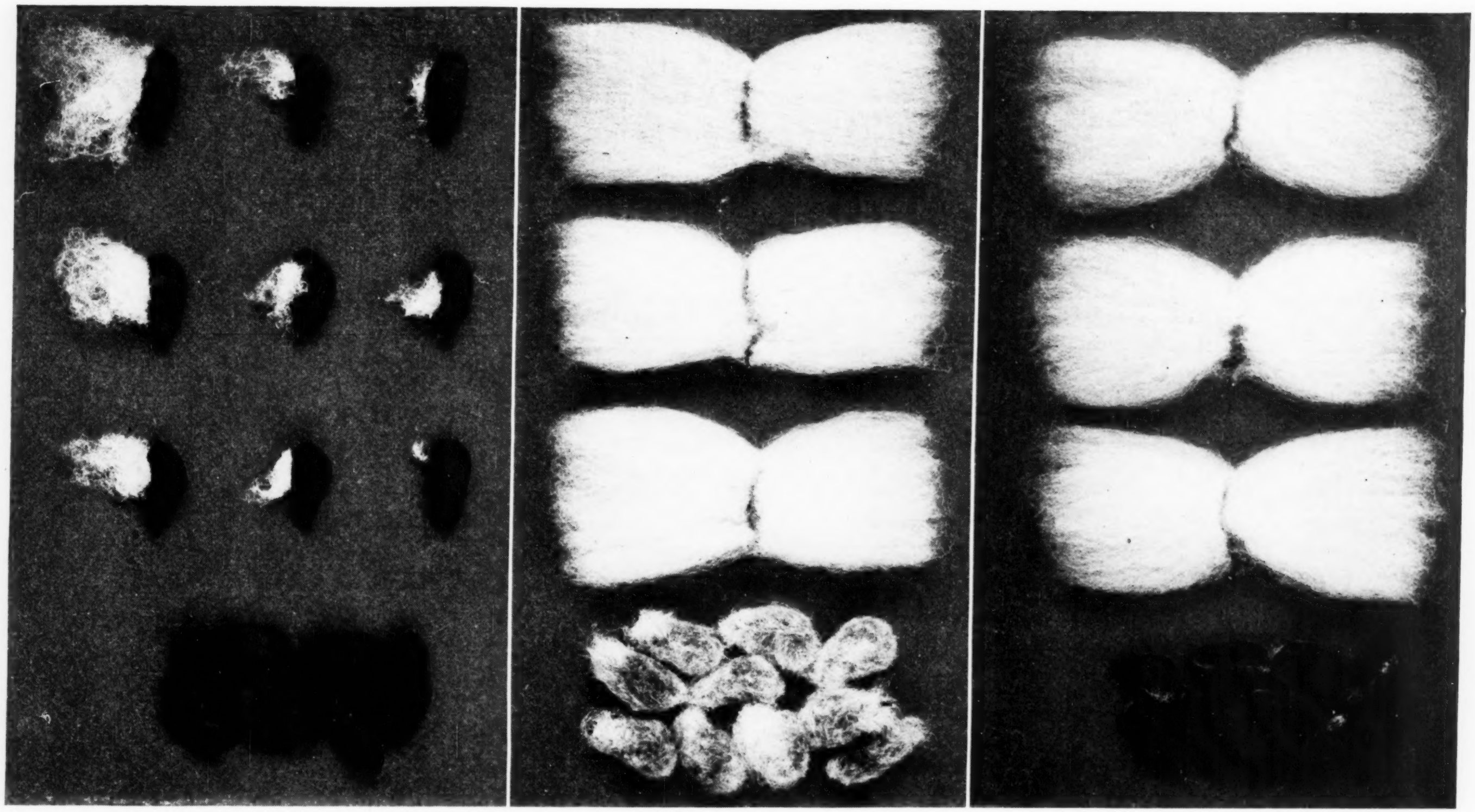
The latter expression is preferable, since it eliminates the influence of variation in the weight of the seeds. But even the lint index is not a simple character, as it depends upon the length as well as the number of lint hairs and lint length, itself, is almost certainly controlled by several factors.

Thadani,[45] crossing two Upland cottons, one having naked seeds and very sparse lint, the other entirely fuzzy seeds and abundant lint, found abundant lint dominant and a close approximation to a 3:1 ratio in F_2. He concluded that his data indicate complete linkage of naked seed and sparse lint. In a later publication[46] he gives similar results as to the inheritance of abundance of lint from crosses between a "No lint" form of Upland (lint index 0 to 1.0) and four Upland varieties having relatively abundant lint (lint indices 3.0 to 5.5).

Griffee and Ligon[10] crossing a lintless smooth-seeded Upland with a lint-bearing, fuzzy-seeded Upland, found an approximate ratio in F_2 of 1 (lintless smooth) : 2 (linted smooth) : 1 (linted fuzzy). They conclude that a single factor (L) controls both characters.

Ware[49] crossed a "scant lint" Upland having a lint percentage of only 5.5, with each of three Upland varieties having abundant lint (average percentage 34.3). He considered his results to indicate monohybrid segregation, but, as shown in his graph, the gap between the two classes in F_2 amounts to only 1.0 per cent, and his F_2 population appears to have been the combined progenies of crosses between "Scant Lint" and three abundant-linted varieties which differed in their lint percentages.

Results reported by McLendon,[38] Kottur[33] and Kulkarni and Khadilker[34] do not afford evidence of discontinuous inheritance of lint abundance. Harland[17] has pointed out the fallacy of regarding values such as lint percentage and lint index as Mendelian characters. It is only the extreme sparseness of lint often associated with naked seeds which is likely to show discontinuous inheritance.



LINKAGE OF SEED FUZZINESS AND LINT ABUNDANCE

Figure 9

Seeds of Upland cotton before and after removal of the long lint hairs, showing the relations of seed fuzziness and lint abundance. W. W. Ballard crossed the naked-seeded, sparse-linted form (left) with the fuzzy-seeded, abundant-linted form (center) and obtained a first generation progeny which was uniformly naked-seeded and abundant linted (right). The second generation segregated into three classes, naked, abundant; naked, sparse; and fuzzy, abundant. The combination fuzzy, sparse was not represented The proportions indicate close linkage of the genes of the two characters.

Evidence of Linkage

Very little evidence of linkage of genes in Gossypium has been obtained. The large number of chromosomes (haploid number 13 in Asiatic cottons, 26 in American cottons) and the fact that most of the characters whose inheritance has been studied involve several genes, make it difficult to determine linkage relations in this group.

Thadani[45] obtained data from crosses between Upland cottons which he thought proved complete linkage of the genes for naked seed and very sparse lint as contrasted with fuzzy seeds and abundant lint. Similar data were obtained by Ballard (Figure 9) and reported by Kearney and Harrison[31] (p. 214). In both cases the double recessive class, fuzzy seeds with sparse lint, was not represented in the F_2 population. Thadani considered his data to indicate absence of crossing-over. Griffee and Ligon[10] and Harland* attribute the characters naked seed and sparse lint to the action of a single gene but in this connection it may be observed that an Upland family at Sacaton homozygous for naked-seed has been found to segregate rather pronouncedly in respect to lint abundance.

Data also presented by Thadani[45] indicate that there may be linkage not only between the genes for seed fuzziness (*Aa*) and lint abundance (*Bb*) but between the genes for leaf color (*Gg*) and habit of branching (*Dd*), between the genes for leaf color (*Gg*) and abundance of lint (*Bb*) and between the genes for leaf color (*Gg*) and seed fuzziness (*Aa*).†

Harland[19] (p. 370) concluded from a study of crosses involving a Red Leaf cotton of the South American group that "the gene *R*, which produces strong anthocyanin pigmentation of stem and leaf, is linked with [petal] spot in all crosses." Carver[8] on the other hand presents evidence that in Upland cottons these characters are independent. In reference to Carver's results, Harland states:[23] "It is somewhat surprising to find red and petal spot independent, since the reviewer, in crosses of red leaf Peruvian and Bourbon with Upland, has found strong linkage between *R* and *S*, the two genes being only about five units apart on the chromosome. It is therefor possible that the red leaf of Upland is genetically distinct from the red of Peruvian or Bourbon." Data presented by Leake[36] indicate that in Asiatic cottons red leaf and general red color of the petal are closely linked or are dependent upon a single gene.

Evidence of linkage of corolla color and petal spot in Upland × Sea Island was presented by Harland[19] (pp. 380-382). In other crosses, there appeared to be no linkage between corolla color and spot or between corolla color and leaf color. Harland concluded that "the spot gene linked with *Y* [yellow corolla color] is not the same as the spot gene linked with *R* [red leaf color]."

Other linkages mentioned by Harland, the evidence for which has not been published, are: corolla color with one of the factors for hairiness and

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*Harland[22] (p. 313) states the matter thus: "Both fuzz and lint are not to be considered alone, but as part of the general hairiness mechanism of the plant. Thus both the factors *T* [Peruvian tufted] and *N* [Upland naked] affect also the distribution of hairs on the base of the corolla. The general effect of *T* is to convert the seed from naked to tufted, to add 25 per cent to the weight of lint per seed, and to put hairs on the base of the corolla. The dominant *N* factor acts as an inhibitor. It removes all fuzz from the seed, about 25 per cent of the lint, hairs from the corolla base, and partly from other parts of the plant."

†The crossing-over among the four pairs of genes assumed by Thadani, as computed by J. H. Kempton from Thadani's data, ranged from 25.4 to 39.7 per cent. Mr. Kempton suggests that the genes for all four characters may be located in one chromosome.

with lint length*;[14] "mean number of loculi in the boll which has one of its genes linked to the gene for yellow pollen"† and node number with leaf color and with the petal spot.[18] Referring to the last-mentioned linkages Harland states:

> So far we have obtained one case in which one of the chromosomes of the Asiatic group may have its representative in the New World group. The genes for red leaf, petal spot and node number are linked in the New World cottons. The gene for red and a node number gene are also linked in Asiatic cotton, though in the latter the genes for red and petal spot appear to occupy the same locus in the chromosome. . . . One of the main genes determining whether the cotton is annual or perennial, that is, whether the cotton possesses a high or a low node number is linked with the factor for red anthocyanin pigmentation of the leaf and stem.[18]

The following conclusions as to linkages in cotton have been announced recently by Harland[22] (p. 313) although the evidence for all of them seems not to have been published:

> In the first linkage group are apparently the following factors: *F* (fuzzy), N^n (a factor for node number) *S* (petal spot) *R* (red) S^m (a petal spot modifier) and P^m (a pollen [color] modifier). The exact distances between these have not yet all been accurately mapped. In the second linkage group are C^r (crinkled) and Y^m (corolla [color] modifier). In the third linkage group are *P* (yellow pollen) and B^1 (a factor governing the number of boll loculi).

Data from an Upland-Sea Island hybrid published by McLendon[38] indicate complete linkage of petal color and pollen color, but no evidence of such linkage was found by Harland[13] in Upland × Sea Island nor by Kearney[27] (p. 31) in Upland × Egyptian.

Linkage in Indian cottons between corolla color and corolla length is suggested by the data obtained by Fyson,[9] Leake[36] and Kottur.[33]

Other reported correlations between pairs of characters, of such a nature as to suggest the possibility that linkage occurs, are:

Stigma length and lint length, reported by Prasad[42]

Boll length and seed weight, reported by Afzal[1]

Lint length and lint color, reported by Kottur[33]

The apparent linkage between length and color of the lint reported by Kottur[33] is supported by the fact that Kearney[27] who crossed an Upland cotton having short, white lint with an Egyptian cotton having long, buff-colored line, obtained a negative and disherent correlation in F_2 (r—.230±.048). The positive correlation between stigma length and lint length found by Prasad[42] was not detected in the Upland-Sea Island hybrid studied by Kulkarni and Khadilker.[34]

Kearney[27] determined the correlations among 38 characters (most of them "quantitative") in F_2 of an Upland-Egyptian hybrid. The number of coefficients computed was 703, of which only 22 were both coherent, *i. e.*, of the sign indicated by the parental relations of the characters, and apparently significant (r/E 3.5 or greater). These were listed in table 14, p. 47. Subsequent investigation (unpublished) showed that several of these correlations were probably of a "physiological" nature, the coefficient obtained in F_1 or in one of the parental families having been apparently significant and of the same sign as the F_2 coefficient. Others were not subjected to this test. The two correlations of which the coefficient in the F_1 or parental population was significantly different from the coherent and significant coefficient

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*This correlation in Sea Island cotton was also noted by Burd.[7]

†Kearney, however, found no significant correlation between these characters in F_2 of an Upland-Egyptian hybrid.[27] In another F_2 population of Upland × Egyptian, comprising 119 individuals, the means, for number of boll locks, of the 84 plants which had yellow pollen and the 35 plants which had "white" pollen differed by only 0.07 ± .07 (data hitherto unpublished).

obtained in F_2 are presented below* as worth further investigation to determine whether linkage occurs.

A number of apparently significant correlations which were disherent, i. e., of sign opposite to that indicated by the parental relations of the characters, were listed by Kearney in the same paper.[27] (table 13, p. 46). The most interesting of these correlations is between color of the leaf pulvinus and hairiness of the petiole. The Upland parent of the hybrid had a deep red pulvinus and hairy petioles, the Egyptian parent had a greenish pulvinus and nearly glabrous petioles, while F_1 approached the Upland parent in pulvinus color and the Egyptian parent in hairiness. In F_2 both characters gave a uni-modal distribution and there was a negative correlation between red color and hairiness (r — .297 ± .046). This correlation has since been determined on five other Upland × Egyptian F_2 populations, always with the same results, the coefficients having ranged from —.292 to —.365 and having been in all cases significant with respect to the probable error. In one of these populations, flowers were selfed on the six individuals which were highest in pulvinus color and lowest in hairiness, a disherent combination in which the dominant phase of both characters is represented. Five of these F_2s bred true, their F_3 progenies having been uniform for intensely red pulvinus and complete or nearly complete absence of hairs on the petiole.

No very satisfactory explanation of this disherent correlation has suggested itself, although the data point to linkage with crossing-over in excess of 50 per cent. The theoretical possibility of such crossing-over was mentioned by Morgan[39] and has been considered by Jennings,[26] while Wellensiek[50] reports its occurrence in Pisum and cites other published statements of the occurrence of the phenomenon.

Pairs of characters which seemed to be entirely independent in the crosses studied by the several investigators are as follows:

Leaf color and leaf shape, McLendon[38] Ware[48]
Leaf shape and corolla length, Afzal[1]
Petal spot and pollen color, Kearney[27] (p. 27)
Petal spot and boll lock number, Kearney[28] (pp. 509, 510)
Petal spot and seed fuzziness, Kearney and Harrison[31] (pp. 212, 213)
Lint color and lint abundance, Thadani[45]
Lint color and seed fuzziness, Thadani[45]

Carver[8] presents evidence from crosses among Upland cottons that there is no linkage among any of the following characters: leaf color, leaf shape, petal spot, pollen color, seed fuzziness. It should be noted, however, that in some cases the departures of Carver's observed ratios from the ratios to be expected in the absence of linkage give a rather high value for x^2.†

Conclusion

It is evident from this survey of the information now at hand that scarcely a beginning has been made in fixing the location of the genes in Gossypium. Because of the large number of chromosomes it would be, perhaps, too optimistic to expect that the genes can be located with anything like the precision attained in Drosophila, for example. Yet doubtless understanding of their relations will advance in propor-

*Character pair	r of F_1	r of F_2	D/E
Stigma index and Calyx gland abundance	+.242 ± .047	—.297 ± .098	4.9
Stigma index and Stamen length	—.246 ± .047	+.452 ± .064	8.8

The term "stigma index" indicates the length of the stigmas as a percentage of the entire length of the pistil.

†Harland's evidence of the occurrence of linkage between the genes for red leaf and petal spot in certain crosses and his comment on Carver's contrary finding have been noted on a preceding page.

tion to the progress made in discovering additional allelomorphic characters. In the light of our present knowledge, it seems clear that evidence of allelomorphism should be sought, not in populations derived from inter-species hybrids but within the same species.

It is the writer's hope that this summary of the data and hypotheses thus far published, with references to the original papers, may help to stimulate interest in the cotton plant as a subject of genetic investigation.

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Books Received

BOOKS are acknowledged in this column as received, and such acknowledgment must be regarded as sufficient return for the courtesy of the sender. As far as space permits, books that contain material of special interest to the readers of the JOURNAL *will be reviewed in later numbers.*

PHYSIQUE AND INTELLECT, *by* DONALD G. PATERSON, Professor of Psychology at the University of Minnesota. Pp. xxvii and 304. Eight Chapters. 10 Illustrations; 12 Figures; 58 Tables. Price $2.50. The Century Co., New York. 1930.

"Beautiful but dumb"—"A strong back and a weak mind"—or are the beautiful good and smart and the ugly wicked and stupid?—328 pages which may throw some light on these very important *r's*.

THE FARM BOARD, *by* E. A. STOKDYK and CHARLES H. WEST, of the Division of Agricultural Economics and the Giannini Foundation of Agricultural Economics, University of California. Pp. ix and 197. 10 Chapters. Price, $2.00. Macmillan Co., New York. 1930.

MEDICAL BIOMETRY AND STATISTICS, *by* RAYMOND PEARL, PH.D., SC.D., LL.D., Professor of Biology in the School of Hygiene and Public Health, and in the Medical School, Johns Hopkins University, Baltimore, Md. Pp. 459. Second Edition, Revised and Enlarged. Price $5.50. W. B. Saunders Company, Philadelphia. 1930.

The best existing antidote against the anecdotal method in the practice of medicine, which, it may be noted, still prevails, even in this enlightened day and age.

RATIONAL EVOLUTION (The Making of Humanity), *by* ROBERT BRIFFAULT. Pp. 302. 16 Chapters. Price $3.50. Macmillan Company, New York. 1930.

GROWING UP IN NEW GUINEA, *by* MARGARET MEAD. Pp. x and 372. 16 Chapters. 24 Illustrations. Price $3.50. William Morrow & Company, New York. 1930.

Oscar Wilde remarked that "children judge their parents and sometimes forgive them." The rising generation in

New Guinea has a different bill of particulars to forgive at least,—and if Miss Mead sees aright, we may well go to school in the art of schooling to the (almost) naked savage!

AMERICAN—The Life Story of a Great Indian, *by* FRANK B. LINDERMAN. Pp. 324. Price $1.60. World Book Company, Yonkers-on-Hudson, N. Y. 1930.

WHAT WE KNOW ABOUT HEREDITY AND ENVIRONMENT, *by* BENJAMIN C. GRUENBERG. Brush Foundation Publication No. 7. Pp. 11. Viking Press, New York. 1930.

And only eleven pages! Considering the space available, not bad at all, but the title is a wee bit ambitious.

FUNGUS DISEASES OF PLANTS, *by* JAKOB ERIKSSON. Translated from the German by Wm. Goodwin. Pp. vii and 526. 22 Chapters, and an Appendix. 399 Illustrations. Charles C. Thomas, Springfield, Illinois. 1930.

THE EXCHANGE OF ENERGY BETWEEN MAN AND THE ENVIRONMENT, *by* L. H. NEWBURG, M.D., Professor of Clinical Investigation, University of Michigan Medical School, and Margaret Woodwell Johnston, Ph.D., Instructor in Internal Medicine, University of Michigan Medical School. Pp. 104. 8 Chapters. Price $2.00. Charles C. Thomas, Springfield, Ill. 1930.

SOME BIOLOGICAL ASPECTS OF WAR, *by* HARRISON R. HUNT, Professor of Zoology, Michigan State College. Pp. 118. 4 Figures; 30 Tables. The Galton Publishing Company, New York 1930.

Said Lord Bacon: "The difference between war and peace is that in times of peace the sons bury their fathers, while in times of war the fathers bury their sons." Professor Hunt now adds another count to the indictment—with evidence that more of the superior fathers bury their sons than do the fathers of the inferior. After all, though, isn't the indictment complete enough and damning enough already to hang any murderer and almost any murderess? Enough evidence is in and we need conviction *without reprieve*, but how?

LAWS CONCERNING BIRTH CONTROL IN THE UNITED STATES. Pp. 39. Price 25c. Committee on Federal Legislation for Birth Control, New York. 1929.

A summary of what the Compleat Birth-controller can impart, and when, and where, and to whom, and still remain within the law, or, as usual, within the maze of conflicting laws in which we are enmeshed.

THE EAST AFRICAN RACE PROBLEM, *by* J. H. DRIBERG. Pp. 96. 3 Chapters. Price one shilling sixpence. Williams & Norgate, Limited, London. 1930.

MENDEL'S PRINCIPLES OF HEREDITY, by the late W. Bateson. Fourth Impression. "A new impression of this classic work, containing a few minor corrections, based upon Dr. Bateson's notes." Pp. 413. Part I, 16 Chapters; Part II, Biographical Notice, etc. 3 Portraits; 6 Coloured Plates; 38 Figures. Price $5.00. Cambridge University Press, London, and Macmillan Company, New York. 1930.

Containing a translation of Mendel's original papers, which have of late not been available in any current publication.

THE EXTENT OF ILLNESS AND OF PHYSICAL AND MENTAL DEFECTS PREVAILING IN THE UNITED STATES, A Compilation of Existing Material, *by* ALDEN B. MILLS. Pp. 83. Publication No. 2. CAPITAL INVESTMENT IN HOSPITALS, The Place of "Fixed Charges" in Hospital Financing and Costs, *by* C. RUFUS ROREM, PH.D., C.P.A. Publication No. 7. The Committee on the Costs of Medical Care, Washington. 1930.

As compared with other estimates, the Committee on the Costs of Medical Care takes a very optimistic view of the prevalence of defects in the population of the United States.

THE FALLACIES OF FATALISM; or, The Real World and the Rational Will, *by* CHARLES E. HOOPER. Pp. 211. 2 Parts, 20 Chapters, 80 Sections. Price 10/6. Watts & Co., London. 1930.

THE FECUNDITY OF NATIVE AND FOREIGN-BORN WOMEN IN NEW ENGLAND, *by* JOSEPH J. SPENGLER. Pp. 63. 41 Tables. Price 50c. The Brookings Institution, Washington. 1930.

Evidence that the native-born are beginning to hold their own in the battle of births, by reason of a stationary birth rate during the last fifty years, contrasted with a rapidly falling birth rate among the foreign-born.